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OUR SEMI-CENTENNIAL NUMBER.

We now can state with seeming certainty that our Semi-Centennial Number will appear on Monday, July 19th, and it will be mailed along with our regular weekly edition of similar date. We can add but little to our mention of last week concerning it, save that, to the 23 especially prepared articles for it that were then listed, we can add the following:

"Present Day Photometrical Practice," by Mr. W. H. Gartley, Philadelphia, Pa.

"Boston Gas Supply During Fifty Years," by Captain W. E. McKay, Boston, Mass.

"The History of the JOURNAL," by Mr. Thomas J. Cunningham.

We fear that two other articles promised will not come to hand in time, in that at the time of writing (Thursday afternoon) they should have been received. We have the satisfaction of repeating that this will be a wonderfully valuable number, and will mark an epoch in the history of gas literature. We again repeat our hope that those desiring extra numbers of the issue will send their orders in at once, that none may be disappointed, when later on they learn that their orders cannot be filled.

BRIEFLY TOLD.

"THE PRACTICAL TESTING OF GAS AND GAS METERS."—We have received, from the press of Messrs. John Wiley & Sons, New York, a book bearing the title given in the heading by Mr. C. H. Stone, Chief Inspector of Gas, Public Service Commission, Second District, New York. The author has not attempted to cover unblazed trails, but rather to compile the most important data available, in book form. It contains some 300 pages, with numerous illustrations, a noteworthy feature being the large number of references. The subjects covered are, "Photometry and Standards," "Chemistry," "Calorimetry," "Specific Gravity and Pressure," and "Meters." It also carries a valuable appendix, which includes the results of a large number of tests on apparatus, conversion factors, etc. In order that the apparatus described may be readily obtained, the maker thereof, with the price as well, is included in each instance. The work of others along the same lines is not only acknowledged but praised, when praise is due, as will be seen from the following: "The report of the Committee of the American Gas Institute on Photometry is the ablest and most thorough utterance on the science of photometry which has been delivered in this country." No attempt is made to argue over the results of various experimenters, but rather to state the facts. The matter is presented in a manner which will make it a valuable text book for students, as well as a handy reference for engineers.

THE ANNUAL MEETING OF THE INSTITUTION OF GAS ENGINEERS.—The The annual meeting of the Institution of Gas Engineers, Great Britain, was held in the hall of the Institution of Mechanical Engineers, London, June 15 to 17. From the lengthy, consecutive and excellently well put together account of the sessions, as printed in the *Journal of Gas Lighting*, we gather that, as can be always safely counted upon, they were of great value and of much interest. Mr. Thomas Glover, of Norwich, made a most acceptable presiding officer, and the members proved willing listeners and prompt contributors to the discussions, with the result that these were almost as worthy as were the set papers. The President's address was really sufficient to give matter for discussion that would well last over a day. Of course, its main content was all of interest, but the two paragraphs towards its close, which had to do with the tar painting of roads, will surely be read with that due diligence which leads to application by many a gas maker in the States. This is a broad subject for us here, although it is more than even that, should the demand for tar on this account become urgent, the tar combination will speedily keep prices down through large importations from Europe, which now come in duty free, and which are likely to continue duty free through the schedules of impost that are now being fixed upon by our legislators in Washington. The paper list was truly an imposing one, and the item of carbonizing surely attracted prolonged and minute attention. The subject was treated more or less connectedly by Mr. J. Ferguson Bell, Mr. Rudolph Lessing, Ph.D., and the report of the Carbonizing Committee, abetted with timely notes on "Some Advantages and Disadvantages of a Hot Coke Conveyor," by Mr. Robert Watson, of Doncaster. A joint discussion on them was had that, though extended, did not contain a meaningless or inappropriate phrase. The Com-

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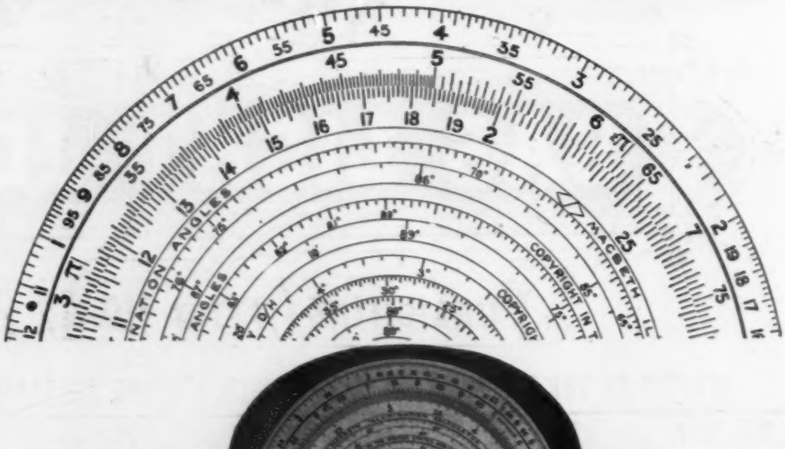
mittees also did excellent work, as witness that (it was virtually committee work, although much of it was done by the Council proper) of Committee on Gas Heating Research, in respect of an "international candle, etc." A good accession was made to the membership list. The "London" gold medal went to Mr. Harold Woodall; the silver medal went to Mr. J. F. Byewater, and the bronze token to Mr. A. F. P. Hayman. The President chosen was Mr. James W. Helps, of Croydon; Mr. Robert G. Shadbolt was elected Second Vice-President, and the Secretary is Mr. S. Y. Shoubridge, of Lower Sydenham. London is to be the next meeting place. The social features were of the usual hearty English type, and not the least to be accorded to complete fellowship therein was Dr. A. H. Elliott, Chemist-Engineer to the Consolidated Gas Company, of New York, whose departure for foreign lands was noted by us some weeks ago.

Handy Formulas for the Macbeth Illumination Calculator.

[Prepared for the JOURNAL, by MR. H. T. OWENS.]

To a large number of people slide-rules and calculators fall naturally into the category of "pesky" things, the value of which is largely theoretical, not practical; or, as some would say, "Commonsense." As a matter of fact, the use of a slide-rule is a much simpler operation than to evoke the long mathematical problems necessary in the calculation of illumination. Further, the possessor of said "pesky" instrument is much more liable to make the enlightening calculations than will his neighbor who is without one; and in order to reduce the matter to the most convenient form, the writer has resolved the various calculations into formulas which cover the necessary operations.



The "Macbeth Calculator," as shown in the figures herewith, consists of two circular, celluloid disks, with runner, by which results are read. The larger disk is divided into two circles, the smaller or center one into nine. The circles are indicated by a letter on the runner, and their use is as follows:

C. Candle power and foot candles.
D. Distance } Multiplication, division and conversion of various
H. Height } units.
J. } Horizontal and vertical angles of incidence.
K. }
L. } Normal angle of ray.
M. }
N. }
O. } Used to determine angle when height and distance are given,
P. } and either height or distance from angle.
Q. }

The calculation of illumination is based upon these two formulas:

$$I_n = \frac{C.P.}{d^2}$$

I_n = normal illumination.
C. P. = candle power.
d^2 = distance squared.

$$I_h = \frac{C.P.}{h_2} \times Cos^3 a \quad I_h = \text{Horizontal illumination.}$$

C.P. = Candle power.
h^2 = Height squared.
$Cos^3 a$ = Cube of cosine of angle of incidence.

The same formula as I_h applies for vertical I .

For any calculations of I_h, I_v and I_n, four factors are involved:

Candle power	C.P.
Angle	a
Height	H
Illumination	I

In order to simplify calculations, always remember that the first two and the last two a'ways come together under the hair line on the calculator. That is to say, readings of either candle power or angle are found together, and height and illumination or foot candles are found together. When any one of the four factors is desired, the operations are as follows:

Candle power.—Set I_h opposite H; bring runner to angle on J. K, L or M; read C.P. on C scale.

Angle.—Set I_h opposite H; bring runner to C.P.; read angle on J, K, L or M scale.

Height.—Set C.P. opposite a; bring runner to I; read height on H scale.

Illumination.—Set C.P. opposite a; bring runner to H; read I on C scale.

When height, distance or angle is desired, the circles D, H, N, O, P, Q are used, and Distance on D always comes under the hair line with Height on H, while Zero on D always comes under the hair line with Angle on N, O, P or Q.

In order to determine which of the four circles containing angles is to be used, the following index is used:

N	scale when distance is from	$\frac{1}{10}$	to	$\frac{1}{8}$	times the height.			
O	"	"	"	"	$\frac{1}{8}$	to 1	"	"	"
P	"	"	"	"	1	to 10	"	"	"
Q	"	"	"	"	10	to 100	"	"	"

Height.—Set angle on N, O, P or Q opposite one on D scale; bring runner to value of D on D scale; read value of H on H scale.

Distance.—Set angle on N, O, P or Q scale opposite one on D scale; bring runner to value of H on H scale; read value of D on D scale.

Angle.—Set D opposite H on the respective scales; bring runner to one on the D scale; read angle on scale N, O, P or Q under the hair line.

For problems in multiplication, division or conversion, only the D and H scales are used, as follows:

Multiplication.—Set number on D scale opposite one on H scale; read answer on D scale opposite other number on H scale.

Division.—Set divisor on H scale opposite number on D scale; read answer on H scale opposite one on D scale.

Conversion.—Use formulæ on back of calculator, bringing numbers designated as D and H opposite each other on the respective scales, then for any value of one unit on one scale, the corresponding value in terms of the other unit will be found opposite. For example:

To convert 14 liters to cubic feet. Set 6 on D scale opposite 170 on H scale, and opposite 14 on D scale read .387 on the H scale. The decimal must, of course, be determined in the same manner as for a slide rule.

To convert 3 cubic feet to liters, use the same setting and opposite 3 on the H scale read 85 on the D scale.

Operating a Water Gas Machine.

[Prepared by Mr. W. J. Bertke for the Fifth Annual Meeting, Iowa District Gas Association.]

The making of gas on a water gas machine seems quite a simple process, at first glance, and such it is, if viewed only from the point of making gas, irrespective of the quality of the gas made or the amount of materials used in making 1,000 cubic feet thereof, but, when we look at it from the practical side, the making of a uniform standard quality, with a minimum quantity of fuel and oil used per 1,000 cubic feet of gas, it is altogether a different question.

In no other process does there seem to be so many variable conditions upon which the success of the desired results depends as in the making of water gas. The generator fuel bed must be in the right condition to break up the steam admitted without making an excess of carbon dioxide, and this condition depends upon the grade and quality of the generator fuel, also the manner in which the fuel is burned. The carburetter and superheater must have the proper heat, the oil must be sprayed on the carburetter bricks in a proper manner, and a great many other things must be watched. If careful attention is not given to details, the results, when figured at the end of a day's run, will not be what you have been striving for, and which you might reasonably expect.

In getting the best results much depends upon the gas maker, his conscientious following of instructions, and his ability to judge conditions for himself. Many things must be determined for him; length of blow and run, degrees of heat to carry in curburetter and superheater, amount of steam per minute, air per minute, etc. Even when following the instructions laid down for him, it is impossible to get the best results every day. Days with poor results will creep in, although during these days he has followed instructions closely and apparently kept the conditions of the set the same as on the days when results were satisfactory. If we can prevent the days with poor results occurring too frequently, or, better still, not at all, the results for the whole month will approach more closely those of our best days.

In the last few years new appliances have been placed on the market, which are of invaluable aid in operating the water gas machine. With these appliances a large burden is lifted from the shoulders of the gas maker, and where, heretofore, we relied on the gas maker's judgment, we now have accurate knowledge to depend upon. These appliances are the pyrometer, the air meter and the steam meter. All these appliances were installed at our works in Sioux City, Ia., last summer.

Previous to installing the pyrometer, the major portion ofthe gas maker's education consisted in learning how to keep the required heat and also to recognize it when he had it. The color of the hot brick looks different on bright days than it does on cloudy days, just as it appears different at night than by day. It meant long experience for the gas maker to be able to operate the set without making naphthaline and lampblack, or have the heat so low that oil was wasted.

The pyrometer indicates the heat in degrees on a dial, and I feel sure all gas works' men realize what an advantage that is over the old method of depending upon the appearance of the brick. Before the pyrometer was installed the standpipe on the set required cleaning every 3 or 4 weeks. Since its installation, we have run a period of 115 days, without cleaning, and at the end of that time barely ¼ an inch of carbon had been deposited.

With the aid of the steam meter we can deliver the exact amount of steam to the generator, under all the varying conditions. With it we can easily proportion the right amount for the up-and-down runs, and we can easily change from one rate to another. Under our present conditions we are using about 31 pounds of steam per 1,000 cubic feet of gas, made on down-runs, and about 34 pounds of steam per 1,000 cubic feet on the up-runs, limiting the amount of carbon dioxide in the finished gas to 4 per cent. More steam is required on the up-runs on account of the condensation in the ash pit.

The manner of burning the fuel in the generator seems to me to require the greatest amount of attention and study to get the best results. The fire, after a run has been taken off, is in need of new life, and the checkerbricks in the carburetter and superheater require new heat. The blast is then turned on and combustion takes place in the generator, forming both carbon dioxide and carbon monoxide. The addition of air to the carburetter consumes this incompletely burned carbon, carbon monoxide, and upon this secondary combustion the reheating of the checkerbrick depends.

Air must be admitted into the generator, not only enough to recuperate the fuel bed, but also in sufficient quantities to provide enough carbon monoxide, so that, when this carbon monoxide is burned, it will reheat the carburetter and superheater bricks. Supplying the air then in the proper amount and in the proper manner, so as to proportion the heat in the different parts of the set, will insure the greatest economy in fuel consumption.

At the beginning of a blow, when the fire is dead, the amount of carbon monoxide passed over from the generator is low and increases as the blow continues. After a down run, before the top of the fire is alive again, the amount of carbon monoxide is also low, and the amount of air admitted to the carburetter for secondary combustion need not be as large as later in the blow. The amount of carbon monoxide passed over into the carburetter is lower in proportion when the rate of flow of air into the generator is high than if the rate is low. Air can be delivered into the generator at such a high rate that very little carbon monoxide is formed and the temperature of the fuel beds correspondingly increased.

The depth of the fire bed in the generator also has an effect on the amount of carbon monoxide passed over into the carburetter. The deeper the bed the greater the amount of carbon monoxide formed. Much depends upon the character of the fuel. It is important that a uniform depth of fuel bed be kept and that the fire zone be kept low. Enough down-runs should be made to keep the clinkers formed near the grates and the fire zone near the bottom. If too many down-runs are made it will be found difficult to hold the heats, besides there is the danger of melting the grate bars. The proportion of down-runs to be made will, therefore, have to be found by experience to fit the local conditions. Care must be taken that a sufficient quantity of air is admitted into the carburetter to burn all of the carbon monoxide, otherwise there will be a loss of available heat.

The condition of the fuel bed in the generator begins to vary from the first run, after cleaning, and continues to vary till the next cleaning time. With a clean fire, which has small resistance to the passage of air, the tendency is to pass too large an amount of air through and at a high rate. With a fire that needs cleaning the tendency is to supply an insufficient quantity of air. With the air meter we measure the quantity of air admitted to the generator, and it enables us to supply the correct amount and at the rate we desire, regardless of the condition of the fire, whether it has a high or low resistance.

Short blows and short runs are to be favored because of the smaller variation in the condition of the set. What the length and proportion should be depend upon local conditions. If the length of blow and run is too short, too much time is wasted in putting on and taking off runs; and here there is a chance for errors to creep in, which should not be overlooked. Care must be taken that the run goes on and off at the exact moment. It is very easy for the gas maker to become careless in this respect, especially if he is using an ordinary clock, and an unbalanced condition results. Let me give an illustration:

Operating under the following conditions, we are making gas on an 8-foot 6-inch set, which has 33 square feet of grate area. The blast period is 3½ minutes, run 4 minutes, and 30 seconds is taken for putting on and taking off the run. We are making about 56 cubic feet of gas per miuute per square foot of grate area, or 7,400 cubic feet per run. Thirty-four pounds of steam are used per 1,000 cubic feet of gas made, making it necessary to admit 63 pounds of steam per minute, or 252 pounds per run. Fifteen hundred and twenty-five cubic feet of air are used to produce 1,000 cubic feet of gas, making it necessary to admit 11,285 cubic feet of air during the blast period, at the rate of 3,225 cubic feet per minute.

The gas maker shortens the blow 20 seconds and lengthens the run that amount, which frequently happens unless he is careful. This is what he is doing: He supplies 10,210 cubic feet of air instead of 11,285, an amount sufficient only to produce 6,690 cubic feet of gas. He admits 273 pounds of steam instead of 252 pounds, or enough to make 8,030 cubic feet of gas, a difference of 1,340 cubic feet. An unbalanced condition would likewise result if the run were shortened and the blow lengthened. Is it any wonder, then, that the results are not uniform, unless the greatest care is taken?

I wish some one would make a clock for the especial benefit of the gas maker. One that has a large-sized second hand, which could be plainly seen from a distance of 12 or 15 feet. The gas maker does not mean to be careless, but, unless he watches closely, he cannot time the period accurately with the ordinary clock.

I think it is very important that the gas maker keep records of th

amount of gas made per run. Not necessarily for each run, as he has not the time to do this; but let him take station meter readings and temperature at outlet of meter and relief holder scale at every coking period.

At present we coke every five runs and readings are taken at that time. The gas maker figures his own make per run, and in this way he knows just what the set is doing. It is also a great help to me in analyzing the conditions, which I could not do if I did not have the records of what has been done from one hour to another.

Organizing and Pursuing New Business Campaigns.

Prepared by Mr. E. H. Martin, Des Moines, Ia., for the Fifth Annual Meeting of the Iowa District Gas Association.

Within the last few years gas companies awoke to the fact that, in order to meet the rapidly changing conditions and prevent large inroads being made upon their business by electric and other competitors, they must have a thoroughly organized and equipped department whose business it would be to educate the people up to the adoption and intelligent use of the various modern gas appliances and the abandonment of the older and less satisfactory manner of doing things. To this end was evolved what is now known as the "Commercial" or "New Business" department, for the organization and efficiency of which thousands of dollars are appropriated each year to maintain, the necessity of and benefits derived from which no longer can be questioned.

Division of the City into Districts.—The first thing to be taken up in organizing a new business department is to become thoroughly familiar with all parts of the city. How best to divide it up, so that in dividing the city by the number of salesmen you expect to put out, you give each one as even a break as possible. This is not an easy thing to do. You will possibly find by development that you erred somewhat in your judgment, and it might become necessary to rearrange each district to properly adjust or balance things up.

Appointment of Salesmen.—It is impossible to suddenly get a working force. A good organization can only be brought about by patience, hard work and time to develop the drones, or those proving their unfitness for the work. The placing of the salesmen in districts where, in your judgment, their peculiar qualifications will be most appreciated and bring about the best results is of considerable importance. In most cities it will be found that the different classes will congregate and be in large numbers in different sections; for instance, the west side of your city will be largely taken up by the well-to-do class. Here you require a bright, snappy, intelligent and well dressed salesman, who can get past the maid or butler, reach the lady of the house easily and, after the interview, have her remember the call kindly, even if she didn't at that time want to buy anything. The north side of your city is settled up with the moderately well-to-do and high-class salaried people. A plainer man with a convincing line of talk and pleasant manner would make good here. The south side is made up of foreigners, among whom are skilled workmen, who usually own their own homes, and laborers who are mostly renters, both classes as a rule having large families. Place here you hard-headed plodder, with a little more age to him than the other salesmen, and if possible a native, or one who can talk the prevailing foreign tongue that is spoken and you will be surprised at the amount of gas these people will consume each month.

Training of Salesmen.—It is not necessary for a salesman to have a technical training in the gas business. He must have a clear, practical knowledge of it to succeed in getting good business. He should know all about the construction of the various kinds of appliances his company handles, and as closely as possible be able to tell what the consumption would be (taking care never to underestimate it); also to demonstrate the simplicity and durability of construction by being able to take appliances apart, especially a gas range. He must be thoroughly familiar with the policies of the company and prices charged for any class of work he may be called upon to do, or appliance to be sold, in order to talk intelligently with his customers. He must be made to understand that, in his position as a representative of a public service corporation, his every move counts for or against the company, and he has obligations resting upon him that do not exist with the ordinary salesman. He must sell that which he knows will meet the requirements of the consumer, not something that will be unsatisfactory in its workings and a constant source of trouble for the company, and sooner or later the loss of the consumer, who will, from that time on, "knock gas and the gas company." He will feel this evil influence in many places thereafter. He must be diplomatic in everything he says and does, and cheerful and happy at all times; it helps sell goods always and is contagious.

Don't degrade a salesman by calling or referring to him as a solicitor. A solicitor can take an order from the order desk marked "See what is wanted," and go out and find out, but has to return to the office and get a salesman to go out and effect the sale.

The new business agent of a company should gain the entire confidence and goodwill of the salesmen in his department, and see to it that there is a spirit of good fellowship and friendliness between his department and all other departments of the company. Build up enthusiasm in your department and it will spread to other departments and increase the capacity for good of the whole organization.

Instructor and Demonstrator.—This is one of the hardest positions to fill and get satisfactory results in a new business department. A woman to fill this position, and have all the required talents the position demands, would be of great value to a gas company.

1st. She must be a monument of tact, and be able at all times to control her temper, as it will be sorely tried many times.

2d. She must have a thorough knowledge of all the cooking parts of the domestic appliances handled by the company.

3d. She must be able to instruct those with whom she comes in contact, as to the proper use of the different burners on an appliance and, if necessary, demonstrate its efficiency and practicability by making a baking on same herself.

4th. She must be a faultless cook. Clean and systematic in her work, she must make everything she does count for good housekeeping in the presence of those seeking practical information.

5th. She should, if possible, create some new dish or manner of doing things in the home which would meet with the hearty approval of the housewife and popularize herself and advertise her company.

6th. She should follow up every range sold as quickly as possible after it is connected, to properly instruct the purchaser in the use of the various burners, if it is necessary, or, if purchaser is already well posted on this, see that the installation is perfect and all burners properly adjusted and consumer entirely satisfied.

Office, Display and Salesroom.—A very important factor in the introduction and sale of gas appliances is an attractive display room, in charge of competent salesmen or salesladies as the size of the city or conditions would warrant. All appliances on display should be connected up so they can be shown as they would work and appear when installed in the home. If the space could be spared, a model kitchen might be partitioned off and equipped with a gas range, water heater and properly placed, with attractive lights. Money spent in this way would be returned many times over in the additional sales the practice would induce. Sales made by the outside salesmen are subject a good many times to inspection of the appliance in question on display at the office. The more attractive the customers find these displays the more liable they are to at once close the deal without further question.

Records of a New Business Department.—The records of a new business department should be as simple as it is possible to make them and yet effective. If you get up an elaborate, cumbersome system and attempt to, from the various records so kept, give the salesmen each morning a bunch of calls, which will consume the best part of that day looking them up, you will meet with very indifferent results. You teach the salesmen to depend too much upon you to tell them where to go to get the business. You in a measure destroy what you are most looking for from them; that is, business of their own creation and by their own efforts and developing resourcefulness under pressure of circumstances.

To provide the salesmen with all the information possible, and at the same time provide a ready and valuable reference for entire office, a card index should be gotten up and after the record is complete it should be kept up to date.

Card Index.—The names and locations of all consumers and non-consumers of gas along the entire system of mains should be gotten up. Make a complete house-to-house canvass in as short a space of time as possible. Put on the work as many men (in addition to the regular new business force) as can be spared from other departments. Avoid hiring temporary men, unfamiliar with the business, whose cards when returned would be half gotten up and of little value. I have seen a good many different ways of filing these cards after being returned by canvassers. The simplest way to my mind is to have cards printed on five different colored card boards, the color of these cards indicating the class of consumer in each case. For instance:

Blue indicating a consumer using—Range, water heater and lights.
Yellow " " " —Range and water heater.
Red " " " —Range only.
Green " " " —Lights only.
White " " " —A non-consumer.

The order in which the cards should be filed in the various drawers or cabinets should be by streets, and cards placed numerically from No. 1 up, not according to the way ledgers are usually run with the odd numbers preceding the even, or *vice versa*. If your city is divided up into sections, as N., S., E. and W., have the N. follow the S. on the same street, separated in the drawer by a metal letter or tag to indicate where 3,500 N., or end of consumers stopped, and where No. 1 S. started. Each day a salesman could be given a certain number of calls taken from the white cards or non-consumers shown in cabinet, and in the district in which he expected to be that day, and changes, if any, as the result of such calls, made by filing clerk. Do not allow at any time any of these cards to be taken from the cabinet unless a change of conditions requires it, and then only by filing clerk, who substitutes a different colored card to meet these changes.

In connection with the card index a file should be kept of prospect cards turned in by salesman and kept in accordance with the future call date shown thereon. When the date shown on card for salesman to call, or the evening before, a similar card, with the name and number of prospect only, should be given to the salesman, the first card remaining on file until second one is returned with notations as to results of second call. By comparison of the first prospect card with second one returned, it could easily be seen whether the salesman really had a prospect or had just turned it in as a bluff. Another benefit derived from this card would be, in case for any reason this salesman should be discharged, what unfinished work he had could be easily followed up. When these prospects bear fruit they should be transferred or made a part of the original index card of proper color.

Simultaneous with the starting of canvassers the drawers or cabinets should be ready, and filing clerk in position, to make changes taking place during canvass, and not go back a great ways over office records to correct by time canvass is finished.

While I never saw it tried out, it is my opinion that a great deal of work could be saved the outside force by having the set and turn on cards made out by the order desk, indicate on the back of duplicate card what the consumer would use at new location, what cards could be checked each day by filing clerk and returned to order department by the time fitters had returned the originals and records completed. This, with a check on the sundry sales each day, would keep card index up fairly well, although the sales made by local merchants to consumers could only be gotten by recanvass of city, which should be done if kept up right at least once a year.

Making out Orders.—Each salesman should make out his own orders and be provided with blank order cards for each classification. The original card or cards should be placed with the order department to be turned over to the disbursing or fitting department, to carry out or complete work as indicated thereon, and the duplicates kept by the order department until original is returned and sent to proper channels for charging for work done and materials used after which original would be filed in permanent cabinet. These cards should be made of card board of sufficient strength or resistance to rough handling, so that when returned by fitter they are not in pieces and hard to decipher what has been done. Under no circumstances send an original contract out with a fitter or any other employee, singly or attached to an order card, and run chances on a part or all of it being lost and having to ask the consumer to sign another in order to perfect your records. As a rule this angers a consumer, who half the time think when they sign the first one it was something entirely unnecessary, and you didn't ask everyone to do it, but singled him out just because you were afraid of him. When you ask him for a second one, and acknowledge your careless business methods in losing the first, you will in most cases get into trouble and meet with a flat refusal.

The forms required, for either gas or gas appliances requiring signature of applicant to them, should be printed with the least possible amount of matter to properly cover the ground. Arrange them so that a clerk at order counter, or salesman on the outside, would have little additional writing to do to have it ready for signature of customer quickly.

Gas appliance order cards should be arranged to cover all gas appliances for which there is a steady demand, and so made that they could be folded in middle and carbon used between, so original and duplicate could be made in one operation. The same thing should follow with meter cards, both turn on and turn off, meter set cards, gas fixtures, house fitting, miscellaneous complaint and order cards and lamps, special cards or forms being used for arc lamps and reflexoliers.

All orders placed on the above cards should be sent to the order department, and from there the originals should be sent to foreman in distributing or fitting department, to be given out to the various workmen to be done. Previous to their being given to the workmen the nature of the work to be done should be copied on a history card, by the history clerk, who should be and usually is under the foreman of the distributing department where record is kept. This history department should have a card for every meter that appears on company's ledgers, showing street and number and floor, flat number or office number which it supplies, if in large buildings, and new cards added for every new set made in a building as soon as meter is placed, and every complaint or order of any kind answered or work done afterwards by distributing department should be accurately kept thereon. This record properly kept is of inestimable value to new business, as well as all other departments, for reference and locating chronic troubles.

If appliances are sold on a basis of part cash and balance in monthly or weekly payments, a form of lease should be used which would legally protect the company to retain possession of the property until entirely paid for, and at the same time show the customer that it was a means to an end that was perfectly fair and considerate to both parties in interest, and bore no resemblance to the lease usually used by easy payment stores, which most poor people get up against some time in their lives to their sorrow, and are, if disposed to meet their obligations, extremely chary of.

Cards for main extension information should be printed so as to show date the extension was canvassed, name of street, starting and stopping points, underneath which should be printed information as to what was expected of signers whose names and house numbers would appear below obligating themselves to take the gas either for fuel or light or both, when main was laid and whether house was piped ready for the gas or not.

Unless the number of houses on a street is sufficient to comply with the company's rule of so many feet of main per house or consumer, it is not well for the canvasser to make a house-to-house canvass and ask for signatures. This excites the residents to further effort to get the company to lay the main, in spite of its not being a paying proposition and get sore if turned down. In answer to a call of this kind just get the number of houses on the street and number of feet of main necessary to cover same, and turn the information into the office for future reference, in case another call comes in, and an immediate answer can be given as to what can be done.

When the number of houses necessary are there, a very careful house-to-house canvass should be made and information card signed by each tenant. If signers enough are procured at first, and some time elapses before the work can be done, it should be recanvassed before main is laid to make sure the people are of the same mind and the extension is a paying one.

While the suggestions contained in this paper, together with the forms accompanying it, are not held up as model methods, or that they are adapted to all cities and towns, they are in use at the present time and seem to bring about pretty good results.

High Candle Power Competition.

[Prepared for the Fifth Annual Meeting, Iowa District Gas Association, by MR. ELMER D. CRADY, Sioux City, Ia.]

Competition we define as common strife for the same object, or strife for superiority. The two high candle power lamps, which are in closest competition to-day, are, I believe, the reflex inverted gas lamp and the tungsten, metallic filament, electric lamp. While nothing can be said against the efficiency of the tungsten lamp, I believe it can be shown that the cost of installation, maintenance and consumption is lower on the reflex inverted gas lamp than on the tungsten electric.

These figures can best be worked up in each local case, as the electric rates differ in different localities, and there will also be different rates in the same town, due to the discounts allowed to varying quantity consumers. Also, discounts on tungsten lamps vary according to the size of our lamp contract.

I am going to use a comparison, similar to that which Mr. M. C. Whitaker used in a paper at Detroit, Mich., June 9th, 1908. He shows the cost comparison of the number of mean spherical candle power, to be obtained for 1 cent with electricity at 10 cents per kilowatt, and gas at $1 per 1,000 cubic feet. He explains his method in this way: "The readings were taking upon the spherical illumination, calculated from readings made in a vertical plane, through the source of light at points every 10° or 15° apart, the readings being taken from lamps having no reflectors." It being fair to assume that reflecting glassware can be applied to either lamps with equal efficiency, the amount to be obtained from the different lamps and the references where he obtained his data follow:

Data for Diagram Showing Comparative Amount of Candle Power to be Obtained for One Cent.

GAS.

Equipment.	Rate pr. 1,000 Cu. Ft	Cons. Cu. Ft. per Hr.	Mean S C. P. of Unit.	Quantity for 1c.		References.
				Cons.	M.S.C.P	
Upright burner, "C" globe	$1	00.5	45.47	10c.ft.	90.94	Practical Illumination; p. 84.
Gas arc lamp, clear globe.....	$1	18.8	302.0	10c.ft.	160.6	Welsbach Test. Laboratories.
Upright burner, clear chimney..	$1	3.7	63.0	10c.ft.	170.3	Practical Illumination; p. 82.
Inverted burner, Reflex.....	$1	3.0	54.0	10c.ft.	180.0	Practical Illumination; p. 90.

ELECTRICITY.

Equipment.	Rate pr. K.W. Hour.	Cons. Watts per Hr.	Mean S C. P. of Unit.	Quantity for 1c.		References.
				Consum.	M.S.C.P.	
Open arc D. C..	$.10	550.0	400.0	100 wts	72.7	Electric World; Vol. 51, p. 1043.
Tungsten lamp..	$.10	102.4	70.6	100 wts	72.29	Electrical Test Laboratory.
Tantalum lamp.	$.10	40.0	17.0	100 wts	42.5	Electric World; Vol. 51, p. 1043.
Inclosed arc lamp.....	$.10	600.0	213.0	100 wts	35.5	Pract. Illumin. Eng.; p. 121.
Gem lamp bulb.	$.10	125.0	40.7	100 wts	32.36	Pract. Illumin. Eng.; p. 42.
Edison lamp, 16 C. P.....	$.10	55.0	13.2	100 wts	24.0	Pract. Illumin. Eng.; p. 26.

This shows that for 1 cent we give 149 per cent. more mean spherical candle power with the reflex inverted gas lamp than can be obtained from the tungsten electric. Using even a 6-cent rate on electricity against a $1 rate on gas, the reflex inverted gas lamp still has an advantage of 50 per cent. over the tungsten electric.

I believe that as the success of the tungsten lamp is due in a large measure to the strenuous efforts put forth by both certain glass and lamp dealers, it is up to the gas men to put forth like efforts, and there is no reason why he cannot get his share, or better, of the lighting business. The reflex inverted lamp is becoming better known, and our workmen understand its regulation better than they did at first and realize its value.

In Sioux City our competition is in the downtown district, and we have had very satisfactory results in competition with the rival electric company. When the reflexolier cluster fixtures came out, we placed an order for 2 three-light clusters, in order to see what we could do with them. Our sales have increased right along and we now have in service: April 15th, 1909, 61 singles, 34 two-light clusters; 46 three-light clusters and 57 four-light clusters. We have also done some window lighting, piping on the independent pilot system, and arranging an alarm clock shut-off. These window installations are easily installed and give an evenly lighted window. At the present time we have in 6 large installations, piped on the independent pilot system, that are giving perfect satisfaction and not requiring much care. In two of these cases we took out the wooden panels in the deck window, replacing them with ¼-inch, ribbed skylight glass, ribbed side down. Using the independent pilot system, the No. 713 reflex inverted lamp, with the slip-joint goose-neck, the former to enable us to remove lamps easily when inspecting. In one of these the windows measured 5 feet deep and 8 feet from the floor of the window to the deck, the total length of the three windows being 40 feet. Here the size of the glass used was 8 inches by 10 inches and we used the No. 6333, concentrating reflector. In another case the panels were 28 inches long and 8 inches wide, but, on account of their length, we used the No. 6321 distributing reflector.

The convenience of having the chain pull by-pass, which is adapted to both the single-unit upright and inverted lights, as well as the gas arcs and reflexolier clusters, has proved a wonderful help. The amount of gas used is so small ($\frac{1}{10}$ of a cubic foot per hour on the inverted lamp) that it is easily made practical. The mantle, hanging as it does in a pendent position from the magnesia ring slipped over the burner tip, allows sufficient play to protect it from vibration.

That the light is a near approach to daylight, and pronounced by many color specialists ideal for truly judging delicate shades and matching colors, is, I believe, a matter of record. For residence lighting the complete lines of domes, fixtures and fancy glassware, lend themselves to good decorative effects. One important feature of the reflex inverted gas lamp is the increased candle power, per cubic foot of gas consumed, which it gives over the old-style upright light. Consuming less gas, as they do, consequently they throw off less heat.

In closing, it might be interesting to show you what our reflexolier clusters, put in up to April 15th, have displaced: Ninety of them displaced single incandescent lamps, mostly the airhole type; 23 of them displaced upright gas arcs; 24 of them displaced electric arcs, which, in most cases, were of the rival company, whose service is 110 volts direct current, and the arcs show the fluctuation; 10 of them displaced tungsten clusters, installed by the rival company; and 8 of them displaced carbon filament lamps.

The Gas Meter.

[Prepared for the Fifth Annual Meeting of the Iowa District Association, by MR. R. H. LAWLOR, Waterloo.]

The subject of the gas meter is a very broad and great question, inasmuch as it is a mechanical device that is an arbitrator between the gas company and the consumer. The meter is owned by the gas company, repaired and tested by the same party, and it is put into the consumer's premises to measure a commodity for which that consumer pays without his personal knowledge of the construction of the meter or of its accuracy. Most gas companies try to show the consumer how it is constructed, also how little chance there is for error; but place yourself in his position and see how you feel about buying any commodity such as gas, electricity and water. In buying your supplies, you are very careful to measure and weigh every article you buy for your company, and also to check every bill carefully; yet in selling to your consumer, you say the meter is absolutely correct, and he has to take your word for it. The point I want to bring out is that some of the smaller companies are not careful enough with our measuring devices; that is we are liable to see a meter with a new case, nicely painted, and say that it is all right, but, upon examination, we find that the meter registers at an error. Also we do not let the consumer see the mechanism of the device and explain carefully enough how it is made and how little chance there is for error. Let me state that we, as companies, ought to put in the best testing apparatus, also the most modern work shop for repairing the gas meter and, above all, the best men possible to get; men who, doing their work completely, are not the men who say, "*That is good enough.*"

As you possibly know, the gas meter as built looks about the same as the first pattern made. The one thing that has been changed is its capacity; that is, the enlargement of the tubes, valves and channels, and their construction to give the least resistance to the passing gas. As an example, the first English 5-light meter's capacity was 30 cubic feet per hour, with a drop of ½ inch in pressure. The "B" type Maryland meter of the same size has a capacity of 95 cubic feet per hour with a like drop in pressure.

The gas meter, as far as construction is concerned, is practically the same as the 2-cylinder steam engine. Its inside is divided into 4 compartments. The two larger, in which the disks move backward and forward, correspond to the cylinder of the steam engine, and the other two compartments in the top of the meter containing the valves

correspond to the steam chest of the engine, the larger one, containing the parts which transmit the backward-and-forward motion of the disk to the valves, also transmits this motion to the index and in this way causes registration of the meter. The operation of the gas meter is as follows:

The gas enters the left hand connection, passes through a channel underneath, to top compartments of the meter, and enters the valve box, and then passes through valves into one of the lower chambers. The pressure of the gas forces the disk hinged with the leather diaphragm away from the walls of the chamber. The flow of gas into this chamber continues until the disk has been forced to the end of its travel, when the position of the valve is changed to open a connection between the chamber, just filled with gas, and the outlet pipe. At the same time, this change in the position of the valve admits a new supply of gas into the chamber on the opposite side of the disk. This new supply forces the disk back to its original position, driving the gas first admitted into the outlet pipe. The alternate filling and emptying of the chambers continue as long as gas is being used. The volume of gas required to push each of the disks back-and-forth to the full limit is carefully calculated, and the cog wheels to which the hands of the registering index are secured are so cut that the volume of gas in cubic feet is registered on the index. In the size of meter generally used (5-light) each compartment passes 72 cubic inches, or 288 cubic inches will drive each disk the full length of its travel and back to its starting point.

After a meter is removed from consumer's premises it is corked and brought to the repair shop, but never tested until the meter has remained in the shop for 5 hours or more. As volumes of gas or air cannot be handled like water or solids, special means are adopted to effect the transfer of contents of the test measuring tanks to the meter. A meter prover, consisting of two tanks, the capacity of one of which has been accurately determined, is marked upon a scale secured thereto. This tank, which is called the holder, is inverted and works up and down in the other tank which is filled with water acting as a seal to prevent escapement or leakage. The raising of this holder is accomplished by suitable chains and pulleys. The holder is also provided with suitable counterbalance weights to maintain the weight of the holder constant, regardless of how much or how little of it is in the water, thus insuring constant pressure of the gas or air contained in the holder.

Proving the Registration of the Gas Meter.—The meter is kept in the room with the prover for several hours to bring it to the same temperature as the air in the room and the water in the tank. This is very important, as a difference of 4° in the temperature of the air or gas increases or diminishes its volume about 1 per cent. On this account it is absolutely necessary to keep the temperature of the air and the water alike from the time it is turned into the prover until it is discharged by the meter. The temperature conditions being right, the meter is attached to the pipe from the prover, and the outlet is plugged, the valve in the connecting pipe is opened to put the pressure upon the meter and connections, then the cock between the meter and the prover is closed. If the pressure, as indicated by the gauge in the connecting pipe remains the same, it shows that the connections are tight and conditions right for the test.

The contents of the holder are now passed through the meter, and when the hand of the meter index is directly over one of the divisions marked on the dial, the valve is again shut off. The holder is now raised to its full extent, and the position of the scale on the holder is adjusted and carefully noted, the valve is again opened and the gas or air in the holder is allowed to flow through the meter until the hand on the dial has made a complete revolution. If the scale on the holder shows that 2 cubic feet of its contents have been used in the test above mentioned, the vessel is registering correctly, but if the scale shows that the holder did not reach the 2-foot mark, the meter is fast, and if the scale shows that the holder passed the 2-foot mark, the meter is slow.

After the meter is tested it is taken to the repair bench, top and back plate and valve are removed, diaphragms are tested for tightness by placing putty on valve seat over diaphragm channel, using flag arms as a guide and pressing diaphragm from outside case to partition, then from partition to outside case. In trying diaphragm one way you may have a leak which will not show, if diaphragm touches bottom or any part of case, thus making a seal, but by trying them both ways, you break the seal and prevent the meter from being repaired which will not register on a small light. If diaphragms are in bad condition, either leaking or dry, it will be necessary to strip and boil out the case, using caustic soda for this bath. After the paint is boiled off it is put in clean water and washed out. In placing new diaphragms the space in the case should be divided equally, so that the diaphragm touches each side equally. This is important so that the leather will take the same position in each travel of the diaphragm. The disks are then put back on the diaphragm and guide wires are so placed on the disks that they do not bind but work freely and allow disk to open and close the proper distance. Then replace flag on disk. Special care should be taken with this so as to have both sides of the diaphragm on the same level and plumb with each other. If this care is not taken, when the diaphragm closes it is liable to lock.

As stated before, all meters that come into the repair shop have top and back plates removed, and if diaphragms are in good condition they are oiled. We oil our diaphragms from the inside through the diaphragm channel, in which way the oil gets to the life of the leather and is an easy way to keep them in good condition. After meter is oiled it is set on both sides, top and bottom, for about ½ an hour to let the oil get to all parts of the leather. Should the diaphragm show a leak at all, we find it better practice to replace it with a new one, as shellac patching over seams is unreliable.

After meter is oiled, it is tried for reach, using flag arm and tangent as a guide, forcing the diaphragm from the partition to the outer case to its full length of travel and setting the tangent toward outlet tube. The flag arm must remain on the outside of the tangent and in the opposite direction the same way. We remove all packing from flag and packing box and replace with new. We do not roll this packing, but put it in flat. By doing this it does not bind but runs smoothly and freely.

Valve-cover arms are then tried for lost motion. If we find lost motion, we remove the angle plate, and if the lost motion is at the crank, and balance arm is in good condition, we remove the arms and cut out lost motion, replace old arms and soldering opening so that it remains tight, if valve should be gummy and work hard. If they should be in bad condition we replace them with new ones.

After valve covers are replaced, arms are tried to see if they are the right length. If not, we do not band or squeeze them, but use valve wrist to set them the proper length.

Valve seats and covers are tried for tightness. They are ground with fine emery cloth on surface plate. When valves are tight inside top, including valve seats and covers, they are washed with benzine and wiped clean with waste, then back plate is replaced. The meter is then taken to the high pressure bench. We try our meters with 18 inches pressure for leaks in soldering. It is then placed on the low light bench, using a small blue blaze for testing the meter to see whether it registers on the smallest possible light. The meter is next taken to the prover and tested, then painted, and it is ready for the consumer's premises.

The proper and careful setting and removing of meters are essentials. The meter should be set free from dampness and excess heat, such as furnaces. There is a great difference of opinion as to the setting of small meters, up to and including the 10-lights. One party says, "Put a shelf under them;" another, "Just support them, such as driving pipe into the wall." We have found the use of the iron connections the best and hang the meter clear of the wall. About half of our meters in Waterloo are prepayments, and we find that, in hanging them with the iron connections we have very little trouble on account of broken connections.

Fitters should be instructed as to the care of a meter. When a meter is removed for test it should always be corked at once, and, if carried in a wagon, a special place should be provided for it so that it can be carried upright. In no instance should a meter be laid flat in a wagon, for the oil from the diaphragm is liable to gum the valves and also the glasses are liable to be broken.

Mutual Interests of the Gas Company and the Community.

[Prepared by Mr. George McLean, Dubuque, for the Fifth Annual Meeting of the Iowa District Gas Association.]

When it is suggested that the public service corporations and the public have mutual interests, a part of the public gives the suggestion hospitable reception, while another part receives it with a cynical, incredulous smile. Loud ridicule is certain to come from quarters in which criticism of such corporations has developed into a profession supposed to be rich in rewards of popularity which may be twined to the advantage of the scoffer.

An objection frequently offered to this or that plan for conserving

the mutual interests of the public and the corporations by which it is served, is that the corporations want it. This is offered as if it were conclusive. It is assumed that any plan acceptable to private enterprise engaged in certain lines of public service is inimical to the public interest. This is a logical assumption on the part of the socialists who condemn private profit in any industry as theft, whether the industry is itself serviceable and legitimate or not. It is illogical on the part of all who profess to believe that profit is legitimate if made in a legitimate industry and not excessive; that society is not ready for governmental monopoly of industry, and that industry requires for its proper development private enterprise, reasonably and intelligently restricted, but free from the menace of oppression. Confiscation is the logic of the doctrine that private property or profit is theft. The removal of private enterprise from the field of public service is the logic of the contention that if the public service corporations favor any particular plan for their regulation, this is reason enough for rejecting that plan.

To deny that the corporation and the public it serves have mutual interests which may be conserved by legislation is to denounce the corporation as a public enemy which should be destroyed; and, in truth, the corporation is a public enemy and should be destroyed, unless it be that, as a general proposition, the waste of governmental or public administration exceeds corporate or private profit. If this is not true, as a general proposition, it follows inevitably that the government should close the whole field of industry to private enterprise and establish a governmental monopoly of ownership and operation. It should enter last the field now occupied by the public service corporations, for the reason that the competition in this field, though it be keen and active, and gives the public a choice of illuminants, powers and fuels, involves little of that duplication of service which is found in other lines of industry and which involves the waste so bitterly resented by the socialists. If the latter could have their choice, they would establish municipal stores and factories first, thereby abating the waste of competition, and municipal ownership of public utilities last, since in this field they would find the least duplication of service and hence the least opportunity to secure economy through consolidation. They favor municipal ownership of public utilities for political reasons, on grounds of expediency, because they can obtain a greater degree of public support for this part of their programme than for any other, the socialist movement seeming to proceed along the lines of least resistance when it is put forward in the form of a demand for municipal ownership of public utilities. In a campaign of this sort they can command the co-operation of newspapers wishing to favor them without offending conservative constituents, and that of thrifty taxpayers. The latter do not so much as suspect the motive of the present campaign to drive private enterprise out of the public utility field by lowering its profit to a point below the rate of interest returned to the lender who has no enterprise and takes no risk. Yet it is only the beginning of a movement to drive private enterprise out of every other field of industry, to "take over" the profits which have been accumulated in these various fields, to treat private property generally as "theft," and to appropriate it as the basis of the "Co-operative Commonwealth," the coming glory of the "Emancipated."

All this should be done, and the sooner the better, if public administration of industry is economical, progressive and reliable as a general proposition; but if the contrary is true, if to secure for the public the best results of industry, it is still necessary to recognize the motive of private profit, if the regulation and not the destruction of private property is the wise course, it becomes a question of how this regulation shall be accomplished.

Automatic regulation is the best. Public opinion condemns restraint of the competition through which this automatic regulation is accomplished, except when the purpose of this restraint is to avoid duplication of service. The physician, dentist or merchant betakes himself to another field if he finds the old one filled by more fortunate competitors and thus, though competition remains, unnecessary duplication of service is avoided, or remedied, without the intervention of the State. But the public utility is a natural monopoly. The State must recognize this or allow the public to be taxed to pay interest on plants which are unnecessary but cannot transport themselves to fields which need them. State and public have recognized the situation. They have recognized that the duplication of plants is not the best means of securing proper regulation of rates, that it is neither an economical nor a just means, but wasteful and self destructive, the common result being a combination which charges the community intesest on two plants, one of which is unnecessary. But some regulation, actual or potential, is necessary. The public must be protected against possible extortion. The public must not be left to the probability that the gas man will find it is to his interest to extend his business by making the lowest rate consistent with good service and a modest dividend on his investment. It cannot be left dependent upon his competitors, the electric light men, to regulate his service for him. They might prefer consolidation, and the public should be protected against this contingency and its possible consequences. The power of regulation must be lodged with public authority that it may be invoked if the necessity arises. There is danger that it may be involved unnecessarily or oppressively; but this is not a sufficient reason for questioning the right of public authority to protect the public interest, which lies in rates and service. It is rather a reason why we should seek the desideratum—regulation so automatic in its operation that it can endanger the rights of public nor the corporation, but it must do justice to both.

This ideal arrangement will be found in a wise application of the sliding-scale plan which, properly instituted, works as automatically as the steam gauge on a boiler. Under this plan, the corporation, if it can make them, is allowed net earnings sufficient to pay a certain dividend upon a capitalization based upon the value of its property as determined by investigation. For every certain increase in this dividend it must make to its patrons a certain reduction from the standard rate. Thus the public is made a partner in the enterprise, and guaranteed full participation in any advantage which may arise from the superior skill, economy and progressiveness of private management.

Public feeling against public service corporations is generally due to suspicion of inordinate profits. This suspicion cannot exist in the presence of the sliding scale with its automatic regulation of profit. The sliding scale seems to answer the question of how the public service corporation can be removed from politics, not only from local but from State politics, and from the field of political discussion. Where this plan exists there can be no excuse for duplicating service, no excuse for a municipal campaign based upon a promise to regulate the rates of a public service corporation and relieve the people of alleged extortion, no excuse for the charge that the public service corporations have corrupted the city council or the State commission. With the rate regulating itself automatically there will be no color of necessity for regulation by the city council or State commission. The sliding scale seems to point the way to peace and goodwill, prosperity and permanency.

A Few Hints on the Gas Plant.

[Prepared by Mr. J. M. H. Young, City Gas Co., London, Ont., for the Canadian Gas Association.]

Have a well organized gang of stokers and make as few changes in your retort house staff as possible. When your plant is large enough and not using mechanical stokers, I think it is advisable to have a stoker for each bench of six retorts. Have him look after all the details of his bench, clinkering, firing, keeping ash pan clean and filled with water, looking after holes in retorts and patching same, flues and air passages kept clean, seeing that the carbon is removed at the proper time, and mouthpieces and lids kept in good order. Have all retort house tools kept in good order, so as to avoid any excuse for poor workmanship. Never allow a stoker to miss a charge on the grounds that it was not properly burned off, make him draw it, and he will soon discover and remedy the cause, as no stoker likes to draw a green charge.

Decarbonizing.—We number our retorts from 1 to 42, and decarbonize from end to end in rotation. I have noticed that in a number of the small plants that this is a matter that is generally overlooked, and have often seen from 15 to 20 inches of carbon deposited at the back end of the retort and from 2 to 4 inches along the sides. It is impossible to obtain good results from retorts in this condition. It is a simple matter to remove the carbon if looked after at the proper time; *i. e.*, place a piece of 4 inch pipe 4 or 5 feet long in the retort and insert a ½-inch steam pipe with return bends, with a nozzle at the outlet end, and the carbon can be removed in 5 or 6 hours with but little use of a bar.

See that the stand pipes and hydraulic mains are kept free from pitch. Have stand pipes thoroughly rodded before each charge. Hydraulic mains should be run off every 24 hours, and refilled with ammoniacal liquor, in order to hold seal, and the heavy deposit in the bottom of main removed once a month.

Firing the Furnace.—When coke is used as fuel, it is advisable to feed hot coke as it is drawn from the retort, as it saves fuel and avoids the chilling effect of cold coke.

Charging.—When uniform weight of coal should be charged, the weight is to be regulated according to the size of the retorts, and the heat that can be maintained to burn off the charge in 4 hours. The capacity of the bench to be ascertained by a faithful and competent man.

Scrubbers.—I think it advisable to run enough water through the scrubbers to hold liquor at about 1½ Twaddle, and allow a little ammonia to pass over with the gas into the purifying boxes, as it increases the active life of the oxide.

Purification.—The greatest saving in purification can be effected by the introduction of from 1 to 2 per cent. of air into the gas. Care should be taken to see that the scrubbers and condensers are kept in good condition, so as to prevent any tar or oily matter from getting into the purifying boxes and choking the trays. We have two boxes 25 feet by 25 feet by 4 feet containing 1,921 imperial bushels of oxide, and we change them on an average of once in 3 months. The following is a report of the operations at the plant during the year 1908:

Yield per pound of coal carbonized	4.96 cu. ft.
Tar, per ton coal carbonized	12.87 gallons
Bench fuel per ton coal carbonized	336 pounds
Oil used, water gas plant, per 1,000 cu. ft. gas made	4.59 gallons
Coke used, water gas plant, per 1,000 cu. ft. gas made	34 pounds
Coke breeze used under boilers per 1,000 cu. ft. gas made	18.83 pounds
Ammonia made per ton coal carbonized,	3.40 pounds

Our yield of ammonia was not up to what it should have been, as we should get about $4.50 per ton of coal carbonized and we expect to obtain better results next year.

Push the Coke Business.—Owing to the low price of tar and ammonia the coke sales are just as essential to the success of a gas company as the gas sales. We sold our entire make of coke last year, and had to import from outside towns to supply the demand. We receive $5.50 per ton for large and $6 per ton for crushed, delivered. Our strongest competitor is selling anthracite at $6 to $6.50 per ton delivered.

The Peoria Electrolysis Case.

The *Electrical World* notes that another stage of the important and long drawn out litigation usually referred to as the "Peoria electrolysis case" was reached on June 22, when Mr. Frank L. Wean, of Chicago, as special master in chancery, filed a second report to the United States Circuit Court for the Northern District of Illinois. The complainant in this case is the Peoria Water Works Company and the defendant is the Peoria Railway Company. The suit, which had been pending in one form or another, for perhaps 15 years, arose out of the damage to the plaintiff's buried water mains alleged to be due to escaping current from the defendant's return electric circuit. It has attracted wide attention among electric and street railway men, owing to similar allegations of damage to water pipes and other buried metallic structures from escaping electricity in other cities. The second reference to the master was to determine, among other things, what remedy could be applied to minimize or prevent the injury complained of.

The master reports that in March, 1908, the railway company was operating about 50 miles of single-track railway in Peoria and vicinity. The rails in use were largely of the girder type, 7 inches high, 60 feet long and weighing 80 pounds to the yard. In the business portion of the city these rails were laid on hardwood ties imbedded in concrete, with the space between the rails and adjoining the rails paved with brick. The return system consists of the rails bonded at each rail joint with two No. 0 copper wires in the manner known as "channel-pin bond." At the time mentioned the "brazed bond" had been applied to about 3 miles of track. This "brazed bond," according to the evidence, is one of the most efficient devices for continuing the electric conductivity of the rail return at joints, but is no more efficient, says the master, than the welded joint or certain other methods of bonding which have been in use for a long time. Where special work existed the rails were cross-bonded. The defendant also had as a part of its return about 6 miles of negative overhead wires running from its power station to different parts of the system. These wires were connected with rail and tracks at one end and at the other to the negative busbar in the power house.

Since the close of the defendant's evidence on the former hearing, the railway load has perhaps doubled, and although the conductivity of the return has been improved by heavier rails, double rail bonds, cross-bonding, additional negative return feeders and, so far as it has been applied, the brazed bond, still the master finds it more difficult to prevent the escape of electric current to the water pipes of the complainant owing to the increased traffic and the passage of large interurban cars. The master holds that the evidence shows that notwithstanding all preventive means adopted the current flow on the water works system has gradually increased; a portion of the current has continued to escape and work damage to the proximate underground metallic structures.

The master says that in many cases the complainant's water mains have been injured and in some cases rendered useless by the return current of the railway company. In these distributing mains since 1893 there have been discovered 119 joint leaks in 30-inch mains, 14 in 20-inch mains, 43 in 16-inch mains and 47 in other mains. Two breaks have occurred in 30-inch mains and 9 in 20-inch mains. Electrical surveys made as late as March 25, 1908, showed the most current flowing on the pipes in about the places where the greatest number of joint leaks and breaks occurred. The pittings in the mains, caused by flow of electricity from the defendant's system, have been constantly increasing in depth, according to the master. On South Adams street, where the depth of a pitting, according to the evidence at the former hearing, was ¼ inch in March, 1908, instances were found where the depth of the pitting was 0.55 inch in a main having metal normally ¼ inch thick.

The defendant offered witnesses who testified that all danger could be prevented by the use of the brazed bond on all rail joints in addition to the present bonding, together with proper cross-bonding and "jumpers" and proper maintenance of overhead negative return wires. On cross examination some of these witnesses testified that the plan proposed could not wholly prevent the escape of the electric current, but that the amount escaping would be so small as to do no damage. The complainant's witnesses controverted this position. The master's finding is as follows:

"The evidence offered on this re-reference fails to disclose any method which will completely or substantially prevent the injury complained of; and all the evidence fails to disclose the discovery, since the hearing under the previous order of reference, of any new principle or fundamental law, regarding the nature and effect of electric current or of any new method of preventing the escape of such current different in principle from those known at the time of the former hearing. In other words, the evidence on this reference, taken as a whole, tends to confirm the findings stated in this special master's former report."

The former conclusions which the master fails to change are in effect that a difference in potential of a fraction of a volt may cause electrolysis, and from the conditions found the ultimate destruction of the complainant's pipes by electricity escaping from the defendant's system is said to be a question only of time and pressure. Further, no method is disclosed by which the complainant, by its own action, can protect itself from the electric currents of the defendant's single trolley railways. Entire removal of electric current from the water mains is impossible, in this case, as long as the return currents are grounded or in electric contact with the earth.

Objections to the master's report have been filed by the defendant's counsel, Mr. John P. Wilson, of Chicago, and Mr. I. C. Pinkney, of Peoria, who contend that many of the findings of the master are contrary to the evidence, particularly the statement that it is more difficult to prevent the escape of current since the former hearing, owing to the increase of traffic and the passage of large interurban cars. Categorically, findings as to injury to pipes, pitting and the alleged injury to the complainant's distributing system are objected to as being contrary to the greater weight of evidence.

The next step in this litigation probably will be a motion by the complainant's attorneys to have the master's report confirmed by the Court. Undoubtedly the judge hearing that motion will take the case under advisement, and it will probably be some time before the Court's decision is announced. Accompanying the master's report was about 1,000 pages of typewritten testimony taken on the re-reference.

MR. WILLIAM ECKERT, of Lancaster, Pa., has been employed by the New York and Richmond Company to take charge of its service system.

Present Tendencies in Technical Education.

In his address to the Society for the Promotion of Engineering Education, delivered some days ago by Dr. Frederick E. Turneaure, he noted that so long as division of labor continues to develop, thus separating more and more the producer from the consumer, the engineer will be called upon in ever increasing numbers to develop and transmit the power, to manufacture and operate the machinery and to provide the transportation facilities on larger and larger scale. Through the development of agricultural machinery, a smaller and smaller percentage of the world's population will be required to procure the raw material for food and clothing, and a constantly increasing percentage will be employed in meeting our wants and necessities in the form of manufactured articles and in transporting them from producer to consumer. A larger and larger proportion will of necessity dwell in large groups involving a complex life, and even the life of the agriculturist will be increasingly complex. All these conditions tend to increase the demand for men trained in the knowledge of materials and the laws of physics and chemistry. In law, medicine and theology, and even in pedagogy, there seems to be little reason why the demand should increase more rapidly than the population and, on some accounts, it is likely to be less rapid. With the engineer exactly the reverse is true.

Different Kinds of Technical Training Needed.—Engineering is commonly and with truth called a "profession." For many technical men it is a profession, but for others and larger numbers it can scarcely be said to be such. The technical requirements requisite for the performance of various duties vary between wide limits. Innumerable callings require a greater or less amount of technical training, some of which might fall within the class generally considered as engineering, while others would not. The profession of the engineer is, for these reasons, somewhat indefinite, and probably will always remain so, unless some formal method be adopted by the State to differentiate by examination, or to recognize examinations conducted by educational institutions. It does not seem important, from the standpoint of the engineering educator, that such differentiation be emphasized; but it is important that the requirements of society in the field of technical education be understood and provided for.

On the one hand, no training can be too thorough, no culture too broad, for the real professional engineer. On the other hand, it is unquestionably true that large numbers of young men who could not possibly afford such a long course, can be greatly helped by technical instruction extending over a period of two or three years. Up to the present time engineering instruction in this country has been confined almost entirely to the standard 4-year course, and the curriculum has been arranged primarily with a view to giving the best possible instruction to students who expect to remain 4 years and no longer. The student who wishes to get some technical training to assist him in his chosen vocation, but who cannot stay 4 years, is not well provided for; the needs of such students have been recognized in but few places. I believe it may be said also, with truth, that the present courses are also not well adjusted for those who wish to secure a more thorough preparation for the profession. Post-graduate work in engineering can hardly be said to be a success. After completing a 4-year engineering course few students find much profit in continuing longer at the school.

More specific provision for both these classes seems likely to receive more consideration in the near future.

Five and Six-Year Courses.—Within the last 2 years much has been done towards the encouragement of longer study by a better development of the 5 and 6-year courses.

It is believed by many that 4 years is long enough for a young man to spend in college, and that he can then profit more by getting into practical work than by remaining longer in school. This is doubtless true of a large proportion of students. But there still remains the fact that breadth of view and thoroughness of training must ultimately be secured by the successful professional man. Experience has shown that it is worth while for the lawyer and the physician to devote a very considerable time in school to liberal studies as well as to their professional courses. The engineer is in no less need of such training; indeed his relatively isolated position during the early years of his professional life would appear to indicate that his need is even greater than that of the lawyer. If this is true, should not the schools encourage such education by a convenient arrangement of courses, the granting of suitable degrees and, on the part of some schools favorably conditioned, by giving exclusive attention to courses of this character?

Concerning "Fundamentals."—It is often said and frequently reiterated that we should teach only fundamentals. We probably all agree to that statement, but might not agree on what are fundamentals. It might fairly be claimed that the fundamentals of engineering are covered by the pure sciences, mathematics, theoretical mechanics and materials of construction. But we all go much beyond these studies in our courses and undoubtedly with profit to the student. The fundamentals of geometry may be considered as the axioms. Given the axioms, a well-trained man can (with difficulty) construct his own geometry. Bridge stresses is simply advanced statics, but this subject is taught in all civil engineering courses. The fact that such a subject can be more readily and effectively learned in school than in practice, and the further fact that a considerable group of students is quite likely to have early use for it in practice, makes it a fair proposition to teach it in school. We must, of course, confine ourselves to the fundamentals of any subject, which simply means, I take it, that we should not take the time of a student in teaching details of practice which he can better learn outside.

Study of Materials.—In technical lines, probably the direction in which advanced work can most profitably be extended is in those studies closely related to laboratory investigations, to theoretical analysis and to the study of properties of materials. In the last-named subject, especially, there is a great need of better knowledge. A new epoch in the study and utilization of materials seems to be upon us, and one of the most promising fields of development in applied science is along these lines. This will carry with it increased laboratory study in chemistry, electricity and metallurgy.

Engineering Research Work.—Closely related to the development of longer courses of study is the recent growth of research in applied science as related to engineering. Following somewhat the growth of the agricultural experiment station, research in the engineering sciences has been very greatly developed during the past 4 or 5 years. In at least two institutions a special organization, called an "engineering experiment station," has been established, whose function it is to carry on research in the engineering sciences, particularly in those directions which most concern the interests of the state in question. Such research has also been greatly promoted and developed in institutions having no special organization for that purpose, the work being carried on as a part of the regular duties of the several departments.

Fruitful research is also of much value in cultivating helpful relations between the teacher and the practical engineer. The latter is coming more and more to utilize the very latest results of experiments in his line, and to look more and more to the engineering investigator for practical assistance in this way.

Short Courses.—The third phase of educational development has to do with courses and methods of instruction adapted to those who can complete only a relatively short curriculum. The 4-year course does not adequately meet the great variety of needs of this class of students. The trade school, as such, is not a school to which the American public seem to take kindly and its development has been very meager in the past. There are signs, however, that the regular trade school, as well as the secondary technical school, is likely to be given much more attention in the future.

Secondary Technical Schools.—Schools of a secondary grade are needed in every large manufacturing center. At the present time there are few opportunities for young men to secure any technical education whatever, except by completing a 4-year high school course, and then by pursuing a regular 4-year engineering course in an engineering school. There is no reason why a large and profitable amount of technical instruction cannot be given without so long a preparation. A thoroughly sound and practical course in mechanics can be taught without calculus, and 2 years' instruction of the right kind will be of great assistance to many workers in industrial life. Such opportunities should and will be offered more adequately than is the case at the present time.

Up to the present time the State has not, in general, extended its support to trade and secondary schools. There is no fundamental reason, however, why this should not be done. Already, in at least 3 States, legislation has been enacted leading in this direction, and trade schools and secondary schools are now being supported by taxation.

Correspondence Instruction.—Correspondence instruction by the State has been established in at least one State and has there been placed upon a sound financial basis. The demand for such instruction has come about largely through the lack of secondary schools in the large industrial centers, although such correspondence instruc-

tion meets other demands as well. It is a notable development which meets a real demand, and which is certain to extend in some form or other.

It thus seems likely that there will develop many more schools in our industrial centers of somewhat lower requirements than the present standard engineering schools. To abolish the 4-year course, and require all students to pursue a 5 or 6 year course, would be unfair to a large number of students who cannot afford the long course. Such action might be justified on the part of privately indorsed institutions, but on the part of State institutions the less well prepared student should not be barred from profiting by technical education. A 2-year or 3-year course, offered side by side with the 5 or 6-year course, would very likely meet his needs better than a 4-year course.

Glass Cutting by Means of an Electric Wire.

Mr. R. L. Jouard, in an interesting note contributed to the *Jour. Am. Chem. Society*, says: While it is often necessary, in laboratory practice, to cut bottles and other glassware for the construction of special apparatus, the methods commonly used are somewhat tedious, besides requiring considerable manipulative skill for good results. The following simple device, however, will be found to combine rapidity with precision, even in the hands of an inexperienced operator. For some time the writer has been using it successfully, and, not knowing of its ever having been used before, publishes it with the idea that it might possibly be of interest to other experimenters.

The method consists in passing a current through a thin resistance wire which has previously been wound about the glass vessel and carefully adjusted. For this purpose the 110-volt lighting circuit may be used, and aside from the resistance wire just mentioned, the only apparatus required is a couple of pieces of No. 18 insulated copper wire, a pair of ringstands or other heavy objects, and a suitable rheostat. The vessel must be perfectly dry, and should have a scratch about ¼-inch long made upon its surface, either on the emery wheel or with a file, in order to provide a starting point for the crack. After joining the ends of the resistance wire to the copper leads, fixing the latter to the ringstands at the desired height, and connecting the rheostat in series, the resistance wire is fastened in a single loop around the glass vessel, so as to pass directly over the file mark, and drawn taut by means of the ringstands. A particle of asbestos paper is then inserted between the crossed ends of the loop, to prevent contact, and enough current is turned on to heat the wire to dull redness. In a few seconds a crack forms at the file mark and spreads rapidly around the vessel—frequently the crack starts and snaps across all at once; in either case, it will be found to have followed the path of the resistance wire perfectly, so that the trueness of the fracture depends entirely on the smoothness and alignment of the wire.

Apart from the illustration just given, which merely describes the cutting of a bottle in two, the method may equally well be applied to more intricate cases, where the fracture is to be a curve or a spiral.

Some Recent Costs of Electric Power Production.

A recent issue of the *Electrical World* gives the following paragraphs of the cost of generating electricity, excluding fixed charges, in 3 plants located in New York State, as deduced from the returns filed with the Public Service Commission of the Second District. At present it is difficult to analyze the cost of production in many of the plants of this State from the returns filed, for the reason that many of the companies are fortunate enough to use hydro-electric power in addition to the steam plant service which they furnish. The number of stations of even moderate capacity which operate steam plants exclusively is greatly limited. The absence of figures extending over several years of operation also precludes technical comparisons of the conditions and results obtained by individual companies throughout a considerable period. Nevertheless, data from single plants covering short periods are suggestive as to the cost of manufacturing electricity under definite conditions of equipment and fuel supply.

The first plant considered is the Utica station of the Hudson River Electric Power Company. This plant has a rated capacity of 6,000 kw. It has 8 Heine boilers of 488-horse power each, and 4 Cahall boilers of 509-horse power each, operated at 175 pounds pressure, the total boiler rating being 5,040-horse power. The electric generating equipment consists of two 1,000-kw. and two 2,000-kw. Curtis-General Electric turbo-alternators wound for 2,300 volts and transmitting power to substations at Amsterdam, Oriskany, Frankfort and Little Falls through step-up transformers located in the station at Utica. A large percentage of the output of the Utica station is devoted to electric railway service. In the calendar year 1908 the station at Utica generated 19,751,300 kw. hours and sold a total of 15,750,930 kw. hours. Of this, 15,502,095 kw. hours were delivered for electric railway service, including the operation of the electrified section of the West Shore Railroad between Utica and Syracuse.

The operation of the Utica plant required the services of 7 engineers, 2 pump men, 5 switchboard men, 25 boiler room men, 3 mechanics and carpenters, 25 coal passers and miscellaneous employees, with 1 clerk and superintendence by 3 officials having general oversight of the Company's electric power plant equipment. Only a small part of the time of the superintendents was assignable to the Utica station. The following table gives the cost of manufacture per kw. hour delivered at the station bus, the average cost per ton of fuel being $2.14. During the year the Company burned at Utica 29,045 tons of anthracite and 5,361 tons of bituminous coal.

Cost of Production at Utica Plant, 1908.

Station superintendence	$483.14
Other steam labor, .227 ct. per kw. hour, or	44,286.91
Fuel, .374 ct. per kw. hour, or	73,649.82
Oil, waste and sundries	797.65
Water	361.65
Repairs, building	464.05
Repairs, motive power	1,315.98
Repairs, electrical equipment	4,677.99
Station expenses	4,563.03
Purchased power, 28,489 kw. hours	237.74
Total, .66 ct. per kw. hour, or	$130,837.96

The average output of this station per day was 54,097 kw. hours, the maximum load on the plant during the year being 6,000 kw.; defining the load factor as the quotient of the average kw. hours per day divided by the maximum possible output at normal station capacity for the same period the result is 37.5 per cent. for the year. The Company reports the cost of the station building to be $337,273.43; the cost of the steam equipment, $268,126.74, and the cost of the electrical equipment, $187,440.10. The excellent cost of production at the station is clearly made possible by the good load factor of the plant and the low cost of fuel per ton.

The second plant is that of the Jamestown Lighting and Power Company, at Jamestown, N. Y. The rating of the station at normal output is 908 kw. and the figures cover the year 1908.

The steam generating equipment consists of one 150 horse power, one 125-horse power and two 150-horse power boilers of the horizontal return-tubular type, the average steam pressure being about 125 pounds. The total boiler rating is 575-horse power. There are five engines and 12 generators in the station. The engine equipment consists of one 12-inch x 21-inch Buckeye compound condensing outfit, rated at 250-horse power; one Armington & Sims 100-horse power engine; one 15½-inch x 26½-inch 300-horse power Buckeye, and two 11-inch x 20-inch Dick & Church 175-horse power engines. The total generator capacity is 908 kw. During the year the plant generated 878,140 kw. hours, or an average of 2,406 kw. hours per day. The maximum load was 487 kw. The labor requirements of the plant were four engineers, one oiler, two firemen and one machinist. Bituminous coal was burned, costing the company an average of $2.74 per ton, the total quantity consumed being 3,750 tons during the year. The coal consumption per kw. hour was 8.54 pounds. The operating cost of the station for the year was as follows:

Cost of Production at Jamestown Plant, 1908.

Station labor, .515 ct. per kw. hour, or	$4,533.20
Fuel, 1.16 cts. per kw. hour, or	10,283.42
Oil, waste and sundries	838.78
Water	46.45
Repairs, building	187.35
Repairs, motive power	1,487.93
Repairs, electrical apparatus	264.45
Total, 2 cts. per kw. hour, or	$17,641.58

Defining the station load factor as in the case of the Utica plant, the Jamestown station had a ratio of 11 per cent. between the aver-

age daily output and the total energy which might have been generated in 24 hours had it been possible to operate the plant at full load for that period. The conditions afford considerable contrast between those prevailing at Utica. In the Jamestown case the Company is handicapped by a somewhat higher cost of coal, but the two chief points against a high station efficiency are the smallness of the demand upon the plant for service in relation to its capacity and the operation of apparatus which to a considerable extent represents a type which would not be installed if a new station were built. It appears that the power load of the Company is small, and this, with the use of belted apparatus to some degree, makes it difficult to generate current at specially low figures. The relative importance of the fuel consumption with cost per unit of output is indicated. With an increased load upon the plant, it is probable that a noteworthy improvement in economy would result, even with no change in the equipment.

The third station considered is that of the Binghamton Light, Heat and Power Company. This station has a normal capacity of 2,000 kw., and in the fire room are 3 Stirling water-tube boilers rated at 375-horse power each and built for operation at 200 pounds steam pressure.

Cost of Production at Binghamton Plant, Last Half 1907.

Station labor and superintendence, .252 ct. per kw. hour, or.	$4,298.75
Fuel, .54 ct. per kw. hour, or	9,186.92
Oil and waste, sundries	807.99
Building repairs	1.99
Repairs, motive power	222.04
Repairs, electrical equipment	92.27
Repairs, station sundry equipment	97.86
Total, .87 ct. per kw. hour, or	$14,707.82

The record covers the last half of 1907. In the engine room are one 700-horse power Corliss engine direct-connected type; one 500 kw. Curtis turbine; one 500-horse power Erie-Ball belted engine, and one 500-kw. Allis-Chalmers turbine. The electric generating units consist of two 500-kw. General Electric three-phase alternators, two General Electric belted alternators rated at 200 kw. each, a 500-kw. Allis-Chalmers alternator, and a 150-kw. Westinghouse motor driven 500-volt generator. The station was operated by a force of four engineers, two switch-board men and five boiler-room attendants. The company burned 3,752 tons of coal during the half year, costing on the average $2.44 per ton. The output during the period under consideration was 1,700,268 kw. hours, and the maximum output in any one day was 17,610 kw. hours. The load factor was 19.4 per cent., which, with the modern equipment and load coal cost, secured excellent station economy. The operating expenses for the half year are as given in the table.

The Electric Theory of Matter.

By Mr. Harry C. Jones.[1]

The work which we shall discuss has primarily to do with the question of the power of a gas to carry an electric current, that is, the conductivity of gases. Gas under ordinary conditions has very little conductivity, but this can be increased in a number of ways; viz., by heating, by exposing them to ultra-violet light, X-rays, etc. But the one to which I wish to call attention is the high vacuum tube, which is a tube filled with a dilute gas. We apply the term "dilute" to gases as we do to solutions. A dilute gas contains a small amount of gas in a given volume. The vacuum tubes are good conductors.

For a number of years the work of the Cavendish Laboratory in general, and of J. J. Thomson in particular, has had to do largely with the question of the conductivity of gases. When an electric discharge is passed through a high vacuum tube, in which the gas is dilute, the so-called cathode rays are noticed; the fluorescent or phosphorescent light which is seen is due to the cathode rays.

What is a cathode ray? There was an international war waged over this question between Germany and England; the Germans said that the cathode rays were nothing but ether vibrations, while the English said this was not true—Sir William Crookes taking the view that these cathode rays were charged particles. Each faction went to work to prove its hypothesis. The Germans performed an experiment by putting a sheet of metal over the end of the glass vacuum tube, and showed that the rays passed through the metal. "We have you!" they said. "Can you imagine fine particles passing through metal?" It was difficult, in the light of what they knew at that time, to think of the atoms of anything shooting through a sheet of metal over the end of a vacuum tube. On the other hand, Crookes performed experiments which showed that these cathode rays are not vibrations of the ether. He interposed in the path of the rays a sort of paddle wheel, which, by the action of the rays on the vanes, was made to move along the glass tracks in the tube. Crookes won the victory. His experiments convinced the scientific world that these rays are not vibrations of the ether, but are material particles.

Thomson wanted to find out something about these particles. What is the mass of these cathode particles? What charge do these particles carry? If we can determine the mass (m) and charge (e), we take a step forward.

For the determination of the actual values of e and m we have one of the most brilliant series of experiments, extending over a number of years, that has ever been carried out in any branch of physical science; and it is to these experiments that I wish to call your attention briefly.

A long cylindrical vacuum tube is filled with dilute gas. At one end we place the cathode; beyond this a perforated anode; and beyond this again a perforated metal plug which is connected to earth. The cathode rays passing through the perforations, strike the wall of the tube at the farthest end, forming a small phosphorescent spot of light. Now if we impress a magnetic field, the beam of light will be bent and will strike the glass at a point different from that struck when there was no magnetic field. Measuring the strength of the field and the deflection, we have the data for calculating the ratio of e to vm.

We now wish to determine the value of v, in order to get the ratio e/m. We insert into the tube two plates of metal, so arranged that the beam passes between them. Upon charging the plates the beam is now deflected in the reverse direction to that taken when the magnetic field was impressed. By suitably charging the metal plates, the electrostatic and the magnetic fields just equalize each other's effect, hence the beam occupies its original position. We can thus determine the value of v, and as we already know the ratio of e to vm, we get the value of e/m. Assuming that this is clear and that we know how to determine the ratio of the charge to the mass of the cathode particles, we take the second step, which is more difficult, involving a still more brilliant series of experiments.

I wish first to call attention to one fundamental fact. It makes no difference what the nature of the gas is, whether air, carbon, dioxide, hydrogen or what not; you always get the same ratio e/m. This is constant for all gases. Also the value e/m is the same, no matter what the metal of which the cathode may be made.

How much charge does a cathode particle carry with it? If we knew the number of particles in a cathode discharge tube, and could measure the conductivity of the gas, we should know the charge carried by one particle. We cannot see the particles; they are moving with velocities, about one-tenth the velocity of light. There is, however, a method of determining the actual number of particles under conditions similar to those in a cathode discharge tube, and men far more capable than I of judging, have said that they regard this as one of the most brilliant pieces of experimental work thus far done.

We have considered the method of determining the ratio e/m. If we can determine e, the charge carried by one ion, we will know m, its mass. Thomson carried out an experiment based on the assumption that both positive and negative gaseous ions act as nuclei for the condensation of water vapor. Water vapor in the atmosphere condenses around charged particles. Suppose we pass X-rays through a balloon flask containing water vapor and a gas which is free from dust. The gas is expanded and condensation of the water vapor takes place in the flask in the form of a fine mist or fog; and it was shown that around every ion in the gas is condensed a globule of water so that the number of globules of water that are formed is equal to the number of ions in the flask. Now all we have to do is to count the water globules! If you were ever present in a thick fog—say the London variety—you can imagine what it would be to try and count the water particles. They are very close together and moving rapidly. How are we going to determine the number of water particles in the gas?

Suppose we knew the total amount of water precipitated in the flask and knew the size of one drop; it is obvious that we could find out the number of drops. By allowing the mist to fall to the bottom, we

1. From the admirable address delivered by Mr. H. C. Jones, before the Schenectady Section, Am. Inst. Elec. Engineers.

can determine the total amount of water in the flask. The size of the droplets can be determined by the rate at which they fall—large ones, of course, settling much faster than small ones. By observing the rate at which the cloud settles, we have at once the value of v or the velocity at which the cloud settles; and knowing v we find, from Stokes' equation, the radius of the drop, r, and so find the volume. Therefore, if we know the amount of water deposited from the gas, and know the volume of one drop, we have all the data necessary for finding the number of ions in the same volume of gas, as it is equal to the number of drops.

And now to determine the charge carried by an ion: We know the number of ions present in the gas; we now pass an electric current through it and determine its conductivity; in other words, we measure the amount of electric current carried by the ions in the gas. Knowing the amount of ions in the gas and the amount of electricity which they carry, we thus find the charge carried by one.

If we know the value of the charge carried by the cathode particle and know the ratio e/m of the charge to the mass, we know the value of the mass. This is approximately one-thousandth the value of the mass of the hydrogen ion. More accurate determinations give about one to eight hundred. Thus we know what the cathode particle is. It is a corpuscle, having a mass 1/800 that of a hydrogen ion; and it carries a negative charge of electricity.

We get the same corpuscle from every kind of gas, whether hydrogen, oxygen, or carbon dioxide, etc. A common constituent can thus be split off from all gases. All elementary substances can be converted into gas; therefore, all elementary substances contain one common constituent, the corpuscle and the old chemical definition of the atom must go, as many others have gone in the last fifteen or twenty years. It is shown that instead of these elementary forms of matter being entirely different from each other, they have one common constituent. What are its properties and what its mass.

The corpuscle, in terms of Thomson's work, contains matter and energy. How do we know that there is any matter in a corpuscle? The only way we can learn is by studying its properties. It has mass and inertia. These are the two fundamental properties of matter—do not confuse mass with weight; there is no greater blunder than thinking of weight as being a fundamental property of matter. Matter changes its weight, depending upon position—its mass remains constant. The corpuscle has both mass and inertia. That looks very clear. Thomson, however, was not sure that the mass and inertia of a corpuscle come from any matter present. It had been shown mathematically that rapidly-moving electric charges may have inertia. What part of the mass and inertia of the corpuscle is due to electricity and what to matter? Fortunately nature has furnished us with a substance called radium, which shoots off both radiations at different velocities The more rapidly moving particles have more mass and more inertia than more slowly moving ones and the mass and inertia of each have been measured. On the assumption that all the mass and all the inertia of corpuscles are due to the electric charge, Thomson was able to calculate how much greater should be the mass and inertia of rapidly moving particles than of slower ones. Thomson based his calculations on the assumption that all the mass and all the inertia of the corpuscle were due to its electrical charge.

As the velocity of a charged particle becomes greater, the value of e/m decreases. The charge remains constant, so it becomes evident that with the increase in velocity, there is an increase in mass. The calculated values agree with the experimental, which fact shows that there is absolutely no reason for supposing that the corpuscle contains any matter at all. All its properties, its mass and inertia, can be accounted for by the electrical charge which it carries. There is no reason to suppose that there is anything present in a corpuscle but the electrical charge.

Assuming that the electron or corpuscle contains no matter; that the mass and inertia are accounted for by the electric charge, the question arises—whence the conception of matter? This question was raised in a paper published some time ago by Ostwald. Some of the points brought up in the paper are rather metaphysical, but one fundamental thing is pointed out. We are accustomed to think of matter as the thing we know and energy as an hypothesis. Instead of knowing matter and hypothesizing energy, all matter is pure hypothesis. To think of carrying water, we think of the bucket in which the water is contained. Matter is the imaginary bucket which contains energy, and is created purely and simply out of our imagination, without the slightest bit of evidence for its existence. It has been created out of our imagination as a carrier for the energy which we know is present. It is rather interesting to know that the statements made in that paper by Ostwald have been for the most part verified experimentally by Thomson.

What is the unit of all matter? There is no matter at all in so-called matter. The ultimate unit of matter is the negative charge. One of the first questions then is, where is the positive charge? One of the first things we learn in connection with electricity is that where there is a negative charge there is also a positive one. In the early work of Thomson he had not found the positive charge. He said he did not know about the positive charge, and this has been the weak point. Where is the positive charge, and what is it doing?

If you take a hydrogen atom and split off the electron, what remains will be positively charged. It is interesting to see how easy it is to reason a thing out, and then go into the laboratory and prove that our conclusion is all wrong. The work I am about to describe was carried on by Lilienfeld, and the experiment was this: Suppose we take a glass tube, properly insert electrodes, an anode and a cathode, and impress not only a high e.m.f., but a heavy current. What will happen? The cathode particles we have been studying pass off from the cathode; if there are any positively charged particles they will go off from the anode. While the cathode particles proceed in straight lines and strike at a given point, the anode particles would proceed in straight lines and strike at a different point. By a series of careful experiments carried out under the supervision of one of the German physicists, Lilienfeld has shown that these anode particles do strike the wall of the tube opposite the anode. A phosphorescent patch of light will be produced there. These anions, if they exist, would permit of being dealt with in the same way as the cathions. If we impress an electrostatic field we ought to be able to deflect them. By impressing the electrostatic field upon these rays, making it of such strength as to overcome the magnetic field, we should be able to determine the value of e. A remarkable thing is that from the ratio of e to m obtained for the anions, assuming that each carried one positive charge, as the cathion carries a negative, the mass of the anion was found to be about ½ to ¼ that of the cathion. It is possible, however, that the anion or positive particle has the same mass as the negative, or again, they may have a mass only ¼ as great. The experimental error is necessaeily so great that we cannot decide between these possibilities.

We have taken up the negative electrons and the positive electrons, but have found nothing to suggest matter; nothing but the electrical energy, positive and negative. You may ask, then, how it is that atoms of one substance differ from those of another substance? First, in the number of electrons present; second, in their arrangement; third, in the movements of the electrons. You know that the different chemical elements have mass and energy; each element having its own definite amount of intrinsic energy, part of which can be converted into heat. The electron theory accounts for all this. We know something of the number, arrangement and movement of these electrons; and their different arrangements and combinations give the different atoms of the various elements.

One other question is that of the ability of the electron theory to explain certain well-known facts. We have had the theory of electric dissociation for a number of years, which is as well established as nearly any so-called law of nature. I have been criticized for that statement.

I believe that there is as much evidence for the general correctness of this theory as there is for any other fundamental law of nature. But there has been one feature of electrolytic dissociation that has been troublesome. How does it take place? Take sodium chloride, throw it into water, and how does electrolytic dissociation take place? How does the sodium get a positive charge, and how does the chlorine get a negative charge? We had no means of determining this until we had the electron theory. See what takes place. The sodium gives off one negative electron to the chlorine; and thus the sodium, having given off one electron or negative charge, is charged positively, and the chlorine having gained one negative electron is charged negatively.

Take the subject of radio-activity: Try to deal with this subject in terms of any theory except the electron theory, and you will come out about where you began. The radium atom is unstable, as you know; it is breaking down. In the early stages it does not shoot off isolated negative electrons, but great groups of them; possibly three or four thousand are carried away as the alpha particles. After a time, the atom becomes more stable, due to these electrons being shot off, and the electrons begin to come off separately. Then when it grows old, these particles become still scarcer; the atom becomes more and more stable; becomes smaller and smaller; and

finally the radium atom passes over into something, in all probability the element lead. An enormous amount of energy is given out by the radium atom, two or three million times as great as you can get from the most exothermic chemical reaction known. The phenomena of radio-activity can, for the most part, be explained by the theory of the electron and by nothing else, as Rutherford has pointed out in a most brilliant manner. The larger the number of electrons in the atom, other things being equal, the more unstable it is.

If we attempt to apply this theory to the Periodic System of the elements—which Thomson has done, and which time will not permit me to discuss in detail—we find that many of the otherwise purely empirical facts, without the slightest bit of physical foundation, can be accounted for and predicted by the electron theory. I think I have said enough to show you how the conception of the electron was developed experimentally; how to determine the mass of an electron; how the ultimate unit of all matter was at first supposed to be a corpuscle containing both matter and energy; how it was shown that the properties of the corpuscle can be accounted for by the electrical charge; and I have tried to make a few applications of the electron theory to a few fundamental facts of science.

The old conception, of the chemical atom of one substance being something fundamentally different from the atom of another elementary snbstance, is gone. The atom of one substance differs from that of another chiefly in the number, arrangement and velocity of the corpuscles present. Atoms fundamentally considered are the same. And finally, the older conception that the chemical atom is a stable, unchanging system, must be abandoned. We now know that at least some of the elements are undergoing a devolution—a breaking down from the more complex into the simpler. This is the exact reverse of the processes of evolution in the organic world, which are building up the more complex out of simpler material.

The Compensation of Salesmen on a Profit Basis.

At the last meeting of the Southern Supply and Machinery Dealers' Association, Mr. C. V. Kellogg spoke an extemporaneous address that was well worth while listening to. In it occur these paragraphs, which would seen worth the close attention of makers of small goods in the gas industrial line:

The temptation and inclination of manufacturers is to do business on volume instead of on the basis of profit. Too many manufacturers fool themselves by figuring that by increasing the volume of their business 25 per cent. they can sell their product for less.

I know of a concern which started out to increase their product 30 per cent., figuring that they could sell their goods for 10 per cent. less on account of the increased production. At the close of the year they found that not only had they not reached the 30 per cent. increase, but their goods had cost them only 5 per cent. less than in the previous year, and in consequence they were making 5 per cent. less profit than the year before. Their action in reducing prices, of course, made the other manufacturers in the same line meet these prices. Mr. Kellogg's suggestion that manufacturers, instead of dinging at their salesmen all the time to get more volume, should take the sales men into their confidence, show them what the goods cost and start them out with directions to sell at a profit, is certainly a good one.

In some lines of business the salesman is paid, instead of a stated salary, a share of the profits. Such concerns come out at the end of the year with the red figures on the right side of the balance sheet. A plan of this kind is all right for the salesman, provided he is a salesman, and not one of the fellows who wants to sell gold dollars for 95 cents.

Items of Interest
FROM VARIOUS LOCALITIES.

"Mr. Chester W. French, a very popular member of the working force of the Denver (Col.) Gas and Electric Company, died at his home in that city the morning of the 20th ult. He was a native of Madison, Wis., where something over a year ago he was a member of the Senior Class in the University. Failing health compelled him to resign his scholarship, and journey to Colorado in the hope of restoring it, unfortunately to no purpose. He was much liked by his comrades here.—V. B."

The Davis & Farnum Manufacturing Company has been awarded the contract for the construction of a gasholder up to retaining 100,000 cubic feet, to the order of the Leominster (Mass.) Gas Company. It is to be completed by November 1st.

At the annual meeting of the shareholders in the Citizens Gas Company, of Kankakee, Ills., the officers elected were: President, Clement C. Smith; Vice-President, Ludington Patton; Secretary-Treasury, Howard Greene.

Mr. S. E. Mulholland, Manager of the Indiana Lighting Company, asserts that artificial gas will be ready for the citizens of Decatur, Ind., by August 1st. If he makes good that promise, Mr. Mulholland and his men will certainly have done a very fast piece of difficult work.

The shareholders of the Hampton-Phœbus and Fort Monroe Gas Company met in Norfolk, Va., the same day (the 23d ult.) that Judge Waddill entered the order confirming the sale of the properties named. They organized by naming the following executive management: Directors, Nathaniel Beaman, George W. Truitt, George A. Schmelz, William Jones, Henry L. Schmelz and Nelson S. Groome; President, G. A. Schmelz; Vice-President, Wm. Jones; Treasurer, H. L. Schmelz; Secretary, N. S. Groome.

Construction work has been commenced (that is, so far as the surveys are concerned) on the new steel power house that is to be constructed by the Massachusetts Lighting Companies on its new plant at North Adams, Mass. It is estimated that the reconstruction and new construction work proposed at North Adams will involve the expenditure of not less than $100,000.

Advices from Indianapolis, Ind., dated June 30th, are to this effect: "The Rushville Gas, Heat and Water Company has filed articles of incorporation with the County Recorder. The concern is capitalized in $100,000, and its articles of incorporation provide for the manufacture and sale of all kinds of illuminating and fuel gas, the laying and maintaining of pipe lines, the digging of wells, the distributing of water and the operating of a water plant. The promoters have purchased the old artificial gas plant in South Jackson street as the basis of their operations. The following Directors, all Indianapolis men, have been elected to serve for 1 year: John A. Walter, Fred. C. Carroll, Henry G. Walter."

A correspondent in Los Angeles, Cal., writing under date of June 26th, informs us that some days before application was filed with the County Clerk for a new corporation to be known as the Los Angeles Gas and Electric Corporation, capitalized at $30,000,000. The applicants were Messrs. W. B. Cline, C. S. Vance, C. A. Luckenbach, T. P. McCrea, W. E. Houghton, A. R. Austin and C. P. Houghton. Mr. Cline is authority for the statement that the only change involved is that the combination is now a "corporation" instead of a "company." He further stated that as soon as the papers were issued the corporation would take over the stock of the Los Angeles Gas and Electric Company, and would also make an offer for the Passadena Consolidated Gas and Electric Company, with the further expectation that they would be operating the latter within 90 days.

The following is the schedule of rates put out by the Indianapolis Gas Company, and effective from the 1st inst.: In any month, the first 1,000 cubic feet, 90 cents; the second 1,000 cubic feet, 75 cents; all consumption in excess of 2,000 cubic feet, 60 cents.

The schedule heretofore existing was: First 10,000 cubic feet, 90 cents per 1,000; second 10,000 cubic feet, 80 cents; third 10,000 cubic feet, 70 cents; all over 30,000 cubic feet, 60 cents per 1,000.

Mr. C. H. Geist, according to a statement published in the Philadelphia *Evening Bulletin* for June 28th, said to a reporter for that paper: "A large amount of money has been paid by me on account of the purchase of the Wilmington Gas and Electric Light Company's plants. I will be its sole owner when the purchase is completed by August 1st. The total price of purchase will be about $2,500,000. I have entered into a contract with the Messrs. Dobson to buy all the stocks and bonds of the corporation, and consider it one of the best deals I have ever made. The plant will be conducted between now and August by the Dobsons. After final settlements have been effected, the name of the Company will be changed to the Wilmington Gas Company. The corporation has an electric franchise, but serves no electric power, and I do not intend to furnish electricity. Not a share of the stock is to be offered for sale, and no one is interested in the deal except the C. H. Geist Company. We intend to improve the properties of the Wilmington corporation extensively. Larger mains will take the places of those now in use, and the latest

methods of furnishing the best service will be installed. Wilmington has a very bright future. It has been steadily building during hard times, and I know of factory interests that intend to spend money there that is bound to increase the importance of the city."

WITH much regret we chronicle the death of Mr. John Causbrook, who will be remembered by many of the old-time engineers and superintendents as the Superintendent of the Bloomfield and Montclair (N. J.) Gas and Water Company. His death occurred at his home, 193 North Park street, East Orange, N. J., from a paralytic stroke. He was in his 68th year. If we mistake not, Mr. Causbrook was, in his earlier days, on the working staff of the old New York Gas Light Company. He retired from active business when the Public Service Corporation of New Jersey secured control of the plants named above.

THE net selling rate of 80 cents per 1,000 cubic feet for gas supplied by the Lynn (Mass.) Gas and Electric Company became effective the 1st inst. If we mistake not, this Lynn rate is lower than any other charged in Massachusetts, save in the city of Boston proper.

THE plant and properties of the Tacoma (Wash.) Gas Light Company have been purchased by the H. M. Byllesby Company, of Chicago. The plant will be largely added to.

THE Roslyn (Va.) Electric and Gas Company has been incorporated by Messrs. M. E. Church (President); Vice-President, G. H. Rucker; Secretary, T. J. King. The latter is a resident of Georgetown, D. C.

DURING an informal meeting of the Committee on Light, Richmond (Va.) City Council, they inspected the completed new construction at the station known as the Lower Gas Works, and declared that the rehabilitation contracts had been carried out to the letter.

WE understand that approximately $150,000 will be expended on the new power station now in process of construction by the San Antonio Gas and Electric Company at the intersection of the San Antonio and Aransas Pass Railroad with the Concepcion road and the Concepcion river. We are glad to say in connection with this Company that Mr. Tuttle has completely regained his health.

THE Cumberland Gas Company, of Providence, R. I., informs us that its plant at Windsor, Vt., has ceased to operate. In fact, the plant is being dismantled.

EX-MAYOR FAGAN, of Hoboken, N. J., is leading a crusading—the gentleman is seldom disengaged at crusading or the like—against the maintenance of the Hoboken gas plant of the Public Service Corporation of New Jersey, on the present site, 14th street and Willow avenue. He suggests the Hackensack meadows as an appropriate spot. So it would be; but would the ex-Mayor be satisfied or willing to stand the expense of removal.

MR. HARLEM DENNIS, division Superintendent of the Scranton (Pa.) Gas and Water Company, has resigned his post, to engage elsewhere. His successor is Mr. Martin Walsh.

NATURAL gas was turned into the mains of the Union Gas and Electric Company, Cincinnati, O., the morning of the 1st inst.

MR. HENRY H. HYDE, for some time Secretary and General Manager of the Racine (Wis.) Gas Light Company, has been transferred to the management of the Tacoma (Wash.) plant recently taken over by the H. M. Byllesby Company. Mr. Hyde is also Secretary-Treasurer of the Wisconsin Gas Association.

MANY residents of San Anselmo, Cal., have petitioned the San Rafael Gas and Electric Light Company to extend its main system to and through their settlement. In fact, at a meeting of the Town Trustees recently held, it was resolved that several lists should be sent out for those desirous of using gas to sign, the petition bearing the restriction that a rate not exceeding $1.50 per 1,000 be made.

THE Highland Gas Company, Quakertown, Pa., has been incorporated with a capital of $10,000.

THE residents of Rensselaer, N. Y., are quite outspoken over the failure of the Albany and Hudson Light and Power Company to extend its main system in a certain section. It is alleged that everything is being done by the management of the Company to oblige the residents to be content with electric currents; which insistence might be conformed to were it not that the people are anxious to secure gas for cooking purposes.

A CORRESPONDENT in Providence, R. I., writing under date of the 2d inst., incloses the following: "Yesterday a cheaper gas rate became effective in Woonsocket, R. I. The rate is to be $1.25 per 1,000 cubic feet, net, in keeping with the announcement made last May by Mr. Thomas Nickerson, Manager of the Woonsocket Gas Company. This city had made an agreement with the Company for a sliding scale, from $1 25 to $1.10 per 1,000 cubic feet in a 15-year term and a 2 per cent. franchise tax, in return for withdrawing opposition to the merger of the Woonsocket and Pawtucket Lighting Companies into the Blackstone Valley Gas and Electric Company. This agreement was made on condition that the merger act passed the legislature. As it did not pass the contract did not hold, but the Company voluntarily granted the reduction. The price is $1.35 per 1,000 cubic feet, gross, less a discount of 10 cents per 1,000 cubic feet for prompt payment. The old rates were $1.35, $1.30 and $1.25 net per 1,000 cubic feet, according to the quantities used per month."

A VERY peculiarly based suit has been brought by the Peoria (Ills.) Gas and Electric Company against Messrs. Todhunter & Alfo, proprietors of a large planing mill concern. The action arises from the installation of a power plant at the planing mill, which was installed for a test to experiment with the comparative cost of steam and electric power for a specified length of time. A contract was drawn and the plant was constructed thereunder. An engineer was retained to watch the test plant during the time the test was on, but nothing was said in the agreement as to who was to pay the engineer. Doesn't that look like a hair splitting peg on which to go to a jury!

MR. GEORGE E. HARRIS has severed his connection with the Fred. K. Wells Company, of this city. He sailed last Saturday on the "St. Paul," for England, and will remain abroad until early September.

FROM the annual report of those in charge of the Alexandria (Va.) City Gas Works it was shown that, in the twelvemonth ended May 31st, the output of gas amounted to 41,000,000 cubic feet, and that the net income exceeded that of the previous year by $1,158.52.

THE properties of the Stillwater (Minn.) Gas and Electric Company, which have for a long time been in the hands of a receiver, were sold at auction the last week in June by the Master-in Chancery, Mr. T. J. McLaughlin, of St. Paul, Minn. The purchasers were Messrs. Homer W. McCoy and Joseph H. Roy, of Chicago, at their bid of $210,000. Our informant adds that Mr. E. L. Hostes, of Stillwater, will unite with the present owners in reorganizing, which will include the plants at Stillwater and the Apple River power plant and lines.

A BULLETIN issued recently by the Denver Natural Electric Light Association, gives the following interesting data respecting the annual kw. hour consumption of varying classes of electric current users. The data are given on the basis of 16-candle power carbon filament lamps, consuming 4 watts per candle power. To get the data, a representative installation of each one of the classes was selected, the consumption for 12 months being taken from the ledger, and the actual equivalent candle power installed was counted. The number of consumers of each class was then multiplied by the average so determined to get the total consumption for that class and the total number of lamps connected:

Sort of Place.	Kw. Hour, per Year.
Dwelling places	52.0
Offices, etc	154.5
Manufacturing industries	62.0
Places of amusement, etc	139.8
Public buildings, repair shops, etc	54.7
Saloons, etc	226.6
Wholesale establishments	80.8
Retail establishments	111.3
Miscellaneous	23.1
Average	71.2

From these averages the final average for the consumption of each 16-candle power lamps for the nine general classes of consumers was derived.

THE AMERICAN GAS LIGHT JOURNAL

The Market for Gas Securities.

The market for Consolidated gas was fairly steady in the week, although whatever change was imminent seemed in the nature of a drop. This, however, is a time in the history of Consolidated shares when it would be the height of folly to sell. If you don't add to your holdings, don't decrease them. The quotations for it to-day (Friday) came at 139½ to 140¾.

Brooklyn Union has again drawn level with Consolidated—139 to 141. We quote Washington (D. C.) gas at 375 to 377, watch it soar when the tariff tinkers are through. Peoples, of Chicago, is 115 bid.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JULY 12.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies,	*Capital*	*Par*	*Bid.*	*Asked.*
Consolidated Gas Co.	$78,177,000	100	139¼	140¾
Central Union Gas Co.—				
1st 5's, due 1972, J. & J.	3,000,000	1,000	98	101
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	—	105
Mutual Gas Co.	3,500,000	100	155	165
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	100	101¼
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	—	100	101
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	104	107
Con. 5's, due 1945, J. & J.	1,500,000	—	97	101
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	94	100
Standard	5,000,000	100	—	75
Preferred	5,000,000	100	70	100
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	100	105
The Brooklyn Union	15,000,000	1,000	139	141
1st Con. 5's, due 1948, M. & N.	15,000,000	—	91¾	93
Yonkers	999,650	500	130	—
Out-of Town Companies.				
Bay State	50,000,000	50	¾	⅞
" Income Bonds	2,000,000	1,000	—	75
Binghampton Gas Works	450,000	100	—	65
" 1st Mtg. 5's	500,000	1,000	90	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	8
Bonds, 5's	5,250,000	1,000	60	60¼
Capital, Sacramento	500,000	50	—	35
Bonds (6's)	150,000	1,000	—	—
Chicago Gas Co. Guaranteed Gold Bonds	7,000,000	1,000	104	106¼
Cincinnati Gas and Electric Co.	29,500,000	100	92	93
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	96	98
Columbus (O.) Gas Lt. & Heating Co.	1,982,750	100	90½	91
Preferred	3,026,500	100	75½	80
Consumers, Toronto	2,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	—	105
Mortgages, 6's	3,600,000	—	—	118
Chesapeake, 1st 6's	1,000,000	—	—	—
Equitable, 1st 6's	910,000	—	—	—
Consolidated, 1st 5's	1,490,000	—	—	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	—	—	100
Denver Gas and Electric	458,000	—	102	105
Detroit City Gas Co	5,000,000	50	—	50
" Prior Lien 5's	4,619,000	1,000	97	100½
Detroit Gas Co., 5's	861,000	1,000	75	80
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	—	101
Essex and Hudson Gas Co.	6,500,000	—	39	40
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Rapids Gas Light Co., 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	—	112	113½
" Bonds, 5's	10,500,000	—	103	103½
Indianapolis	2,000,000	—	60	70
" Bonds, 5's	2,650,000	—	104½	105
Jackson Gas Co.	250,000	50	82	—
" 1st Mtg. 5's	200,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	—	36
Bonds, 1st 5's	3,832,000	1,000	102	104
Laclede Gas Co., St. Louis.	10,000,000	100	—	100
Preferred	2,500,000	100	60	90
Bonds	10,000,000	1,000	104	104¼
Lafayette Gas Co., Ind.	1,000,000	100	—	60
Bonds	1,000,000	1,000	60	65
Louisville	2,870,000	50	143	145
Madison Gas and Electric Co.				
" 1st Mtg. 6's	350,000	1,000	106	108½
" 6 per cent. scrip, due 1910	100,000	25	60	60½
Massachusetts Gas Companies, of Boston	25,000,000	100	63¾	63½
Preferred	25,000,000	100	91	91½
Montreal Gas Co., Canada	2,000,000	100	218	218¾
Nashville Gas Light Co.	1,000,000	100	110	—
Newark, N. J., Con. Gas Co.	6,000,000	—	56	58
Bonds, 6's	6,000,000	—	137	138
New Haven Gas Co.	2,000,000	25	200	—
Peoples Gas Lt. & Coke Co., Chicago	25,000,000	100	115	115¼
1st Mortgage	20,100,000	1,000	—	—
2d "	2,500,000	1,000	104	—
Rochester Gas & Electric Co.	2,150,000	50	88	—
Preferred	2,150,000	50	118	—
Consolidated 5's	2,000,000	—	104¾	105½
San Francisco Gas Co., Cal.	15,500,000	—	—	—
St. Joseph Gas Co.—				
1st Mtg. 5's	751,000	1,000	100	102
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgages, 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	90	95
Syracuse Gas Co., N. Y.	1,975,000	100	50	55
Bonds	2,047,000	1,000	100	104
Washington (D. C.) Gas Co.	2,600,000	50	375	377
1st Mortgage, 6's	600,000	—	—	—
Western Gas Co., Milwaukee	4,000,000	—	—	—
Wilmington (Del.) Gas Co.	600,000	50	230	—

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The P. H. & F. M. Roots Co., Connersville, Ind 79
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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, PA., June 9, 1909.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable July 15th, 1909, to stockholders of record at the close of business, June 30, 1909. Checks will be mailed.

1775-5 LEWIS LILLIE, Treasurer.

Position Wanted

As Manager or Superintendent,

By a man who has had experience and is familiar with the manufacture and distribution of coal and water gas and can deliver the goods. Address, "O. K.,"

1779-2 Care this Journal.

Position Wanted.

A young man wants to make a change, preferably to a company where a knowledge of gas manufacture can be obtained. Has been employed for past two years as new business manager of a gas company in a town of 12,000 inhabitants, and of necessity has had to turn a hand to every side of the gas distribution, as well as to look after an appliance store, fitters and stock. The applicant is a student of the American Gas Institute, a high school graduate, 24 years old and unmarried.

Address, "CENTRAL,"

1778-2 Care this Journal.

Position Wanted

As Superintendent,

By a competent gas man who has had practical experience in all branches of the business, both coal and water gas. At present employed. A-1 references.

1755-tf Address, "R. C.," care this Journal.

Position Wanted

As Bookkeeper or Cashier,

By an experienced gas office man. Best of references. At present employed. Would prefer a live company.

1779-2 Address, "BILL," care this Journal.

POSITION WANTED AS MANAGER.

Gas lighting or new business departments. Thoroughly familiar with all appliances, for both lighting and heating, their construction, installation, operation and sale, with the buying of same, etc. Have had 18 years' experience on both natural and artificial gas, also main line construction and services, house piping, etc. Would prefer locating in the South. Can get the business and show results. State salary in first letter. Address, "BUSINESS,"

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Address, "MANUFACTURER,"

1767-tf Care this Journal.

WANTED,

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1771-tf YORK GAS CO., York, Pa.

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Royal E. Burnham, Washington, D. C. 87

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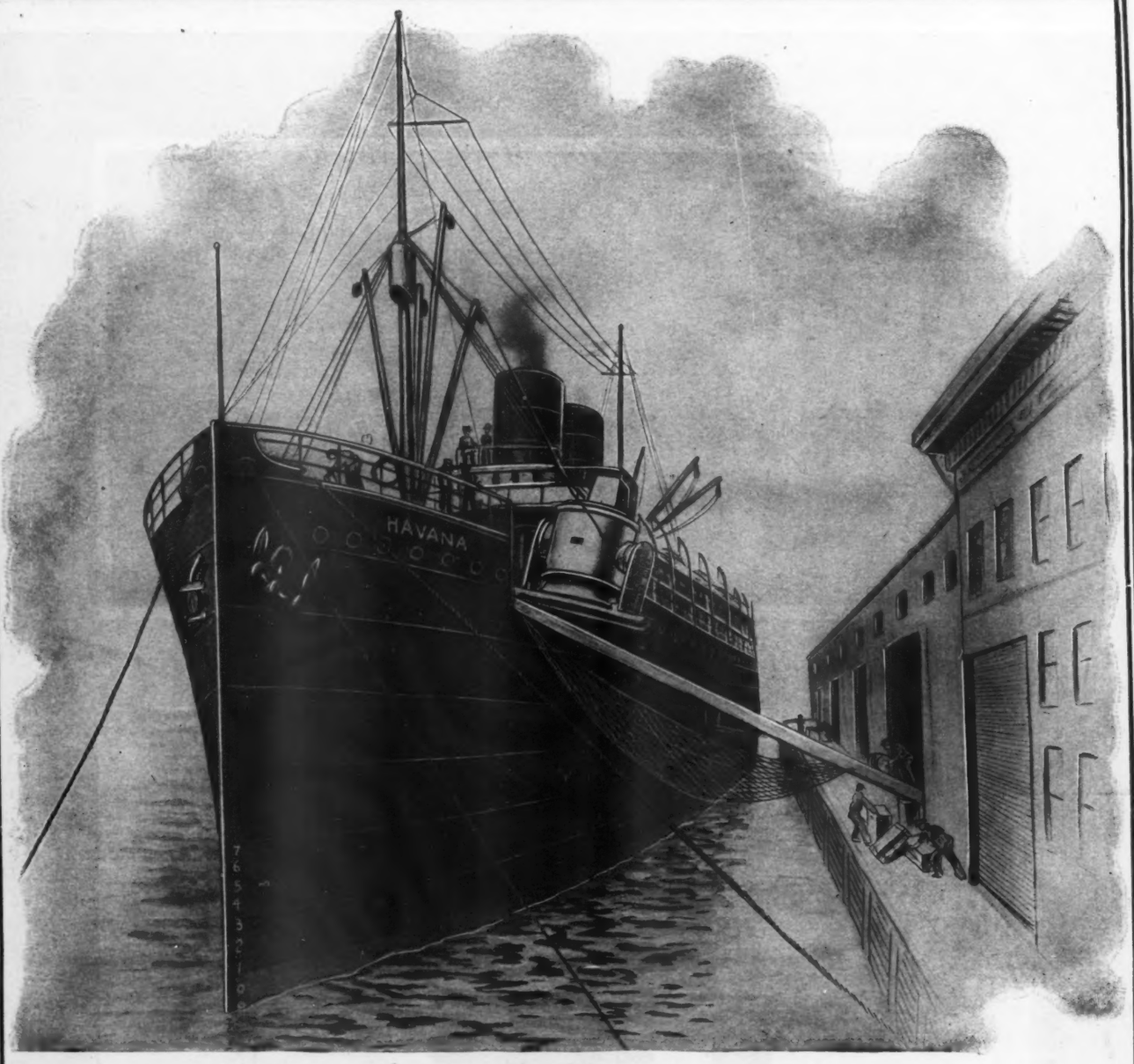

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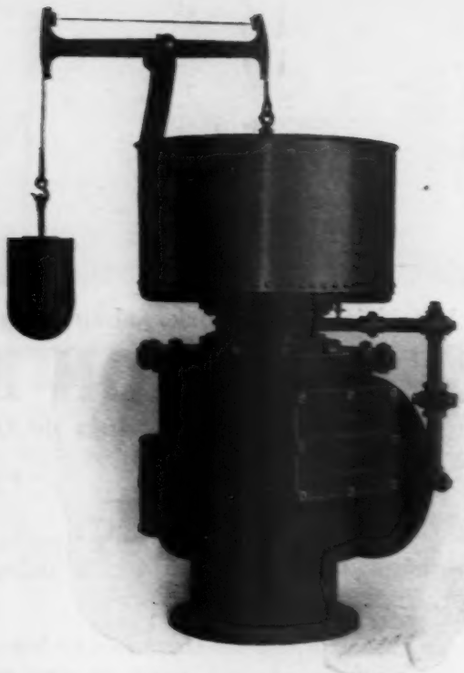

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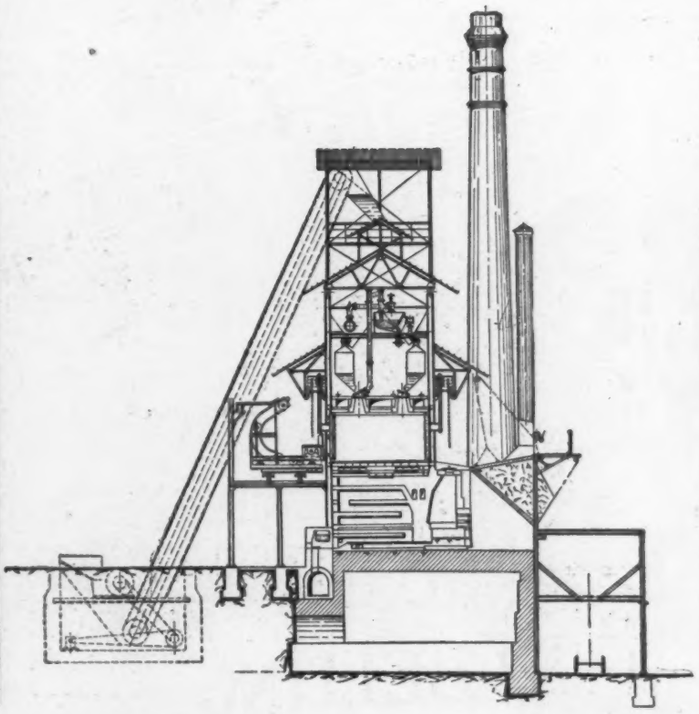

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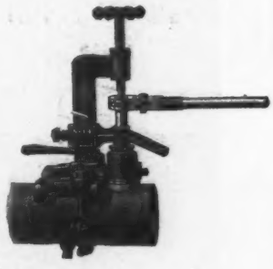

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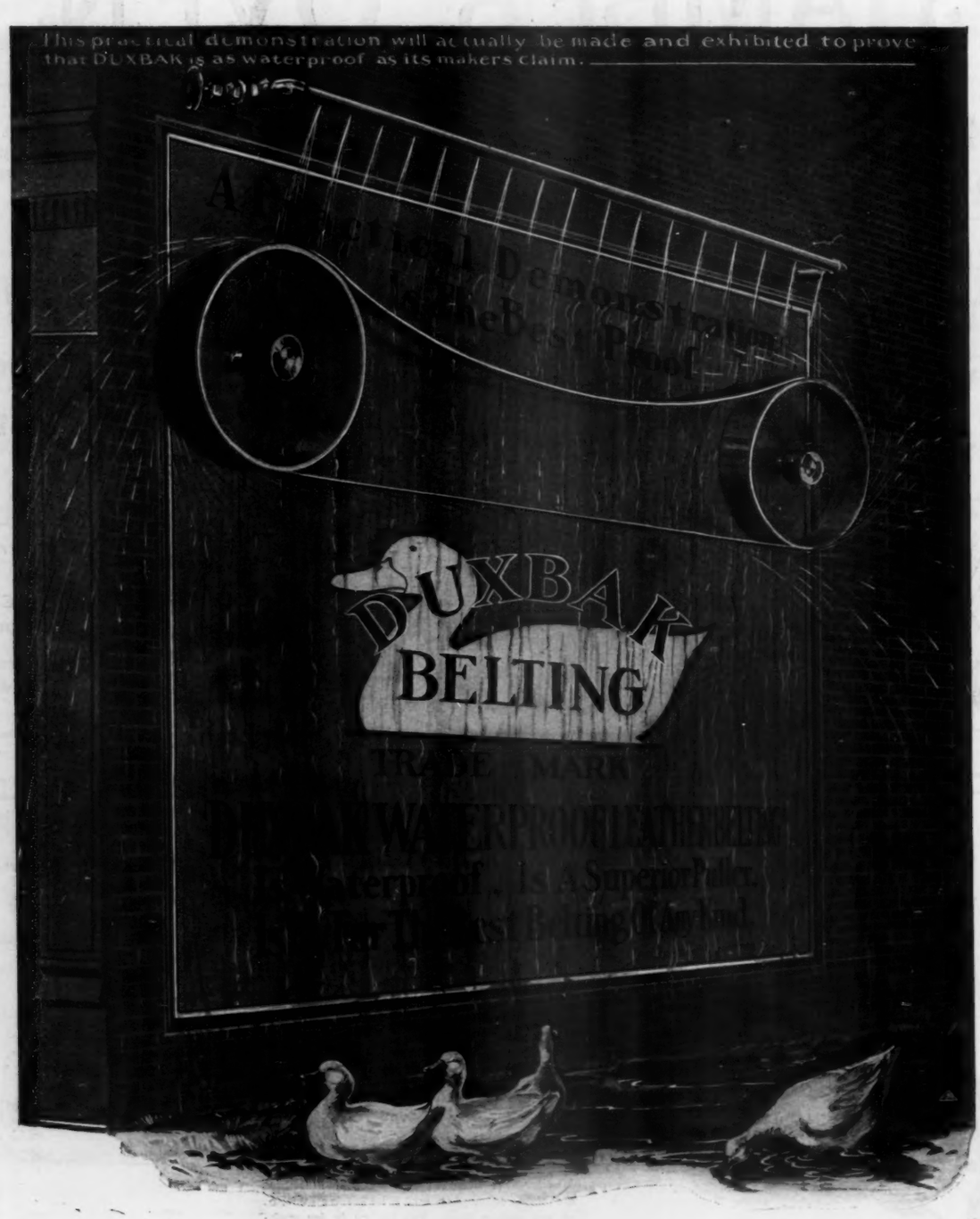
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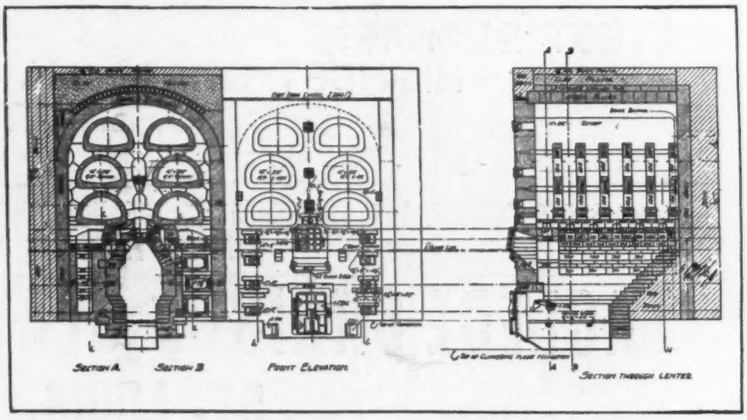

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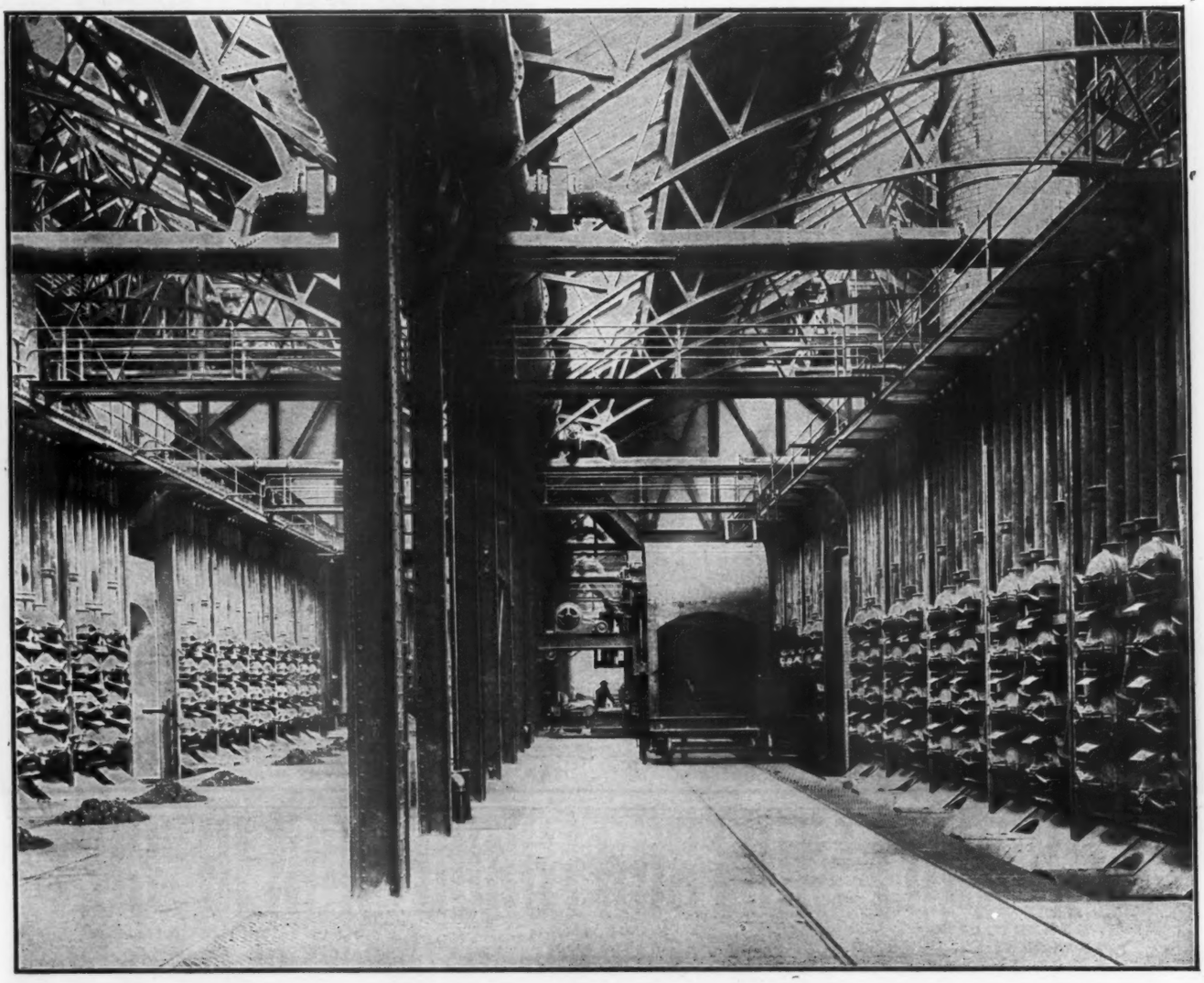

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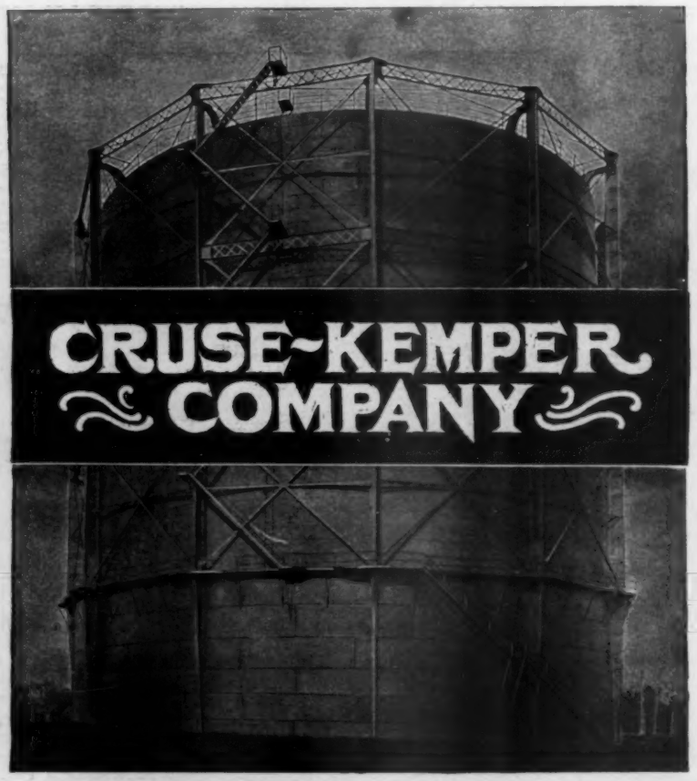

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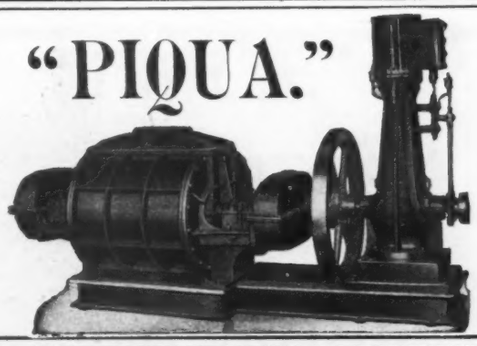

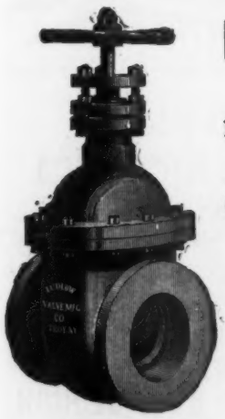

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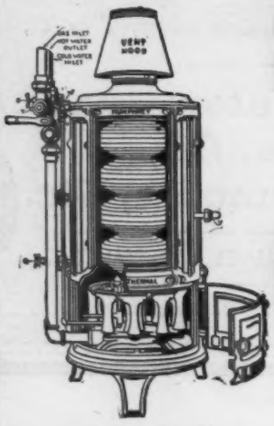

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PUBLIC LIGHTING TABLE.

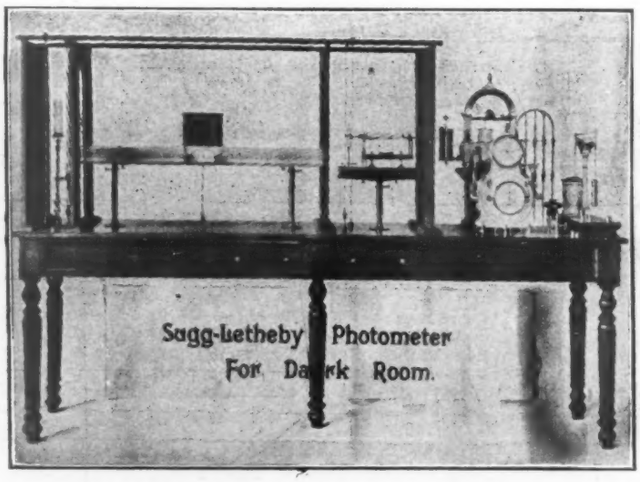
JULY, 1909.

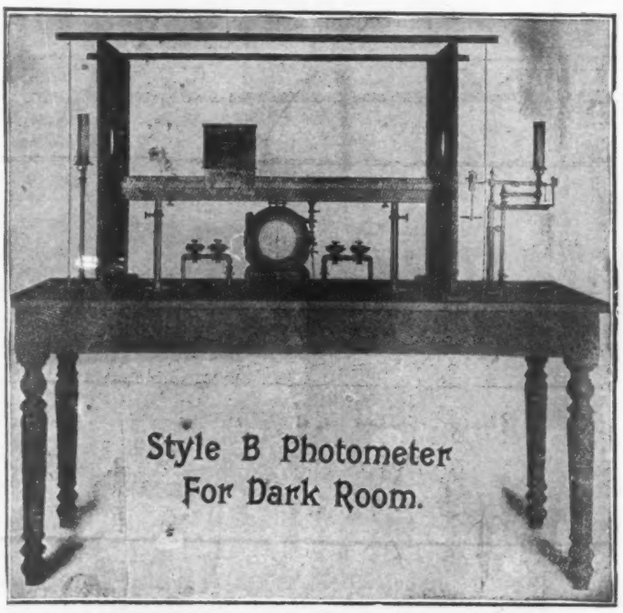
Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.
Thu.	1	2.30AM	3.30AM
Fri.	2	No L.	No L.
Sat.	3	No L FM	No L.
Sun.	4	No L.	No L.
Mon.	5	8.00PM	10.40PM
Tue.	6	8.00	11.20
Wed.	7	8.00	11.50
Thu.	8	8.00	12.20AM
Fri.	9	8.00LQ	12.50
Sat.	10	8.00	1.20
Sun.	11	8.00	1.50
Mon.	12	8.00	2.20
Tue.	13	8.00	3.40
Wed.	14	8.00	3.40
Thu.	15	8.00	3.40
Fri.	16	8.00NM	3.40
Sat.	17	8.00	3.40
Sun.	18	8.00	3.50
Mon.	19	8.00	3.50
Tue.	20	8.00	3.50
Wed.	21	9.10	3.50
Thu.	22	9.30	3.50
Fri.	23	9.50	3.50
Sat.	24	10.20	3.50
Sun.	25	10.40FQ	3.50
Mon.	26	11.10	3.50
Tue.	27	11.40	3.50
Wed.	28	12.20AM	3.50
Thu.	29	1.10	3.50
Fri.	30	2.10	3.50
Sat.	31	No L.	No L.

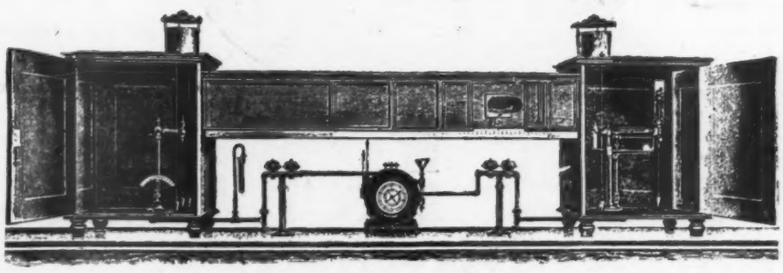
TOTAL HOURS DURING 1909.

By Table No. 1.

	Hrs.Min.
January	212.20
February	183.40
March	173.00
April	151.10
May	144.10
June	138.50
July	145.40
August	160.30
September	180.00
October	201.00
November	216.30
December	233.40
Total, yr.	2140.30







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PUBLIC LIGHTING TABLE.

JULY, 1909.

Day of Week.	Date.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Complete Lighting in One Hour	Complete Extinguishing in 50 Minutes
		From Time Given	
		P. M.	A.M.
Thu.	1	7.27	3.07
Fri.	2	7.22	3.07
Sat.	3	7.22	3.07
Sun.	4	7.22	3.07
Mon.	5	7.22	3.07
Tue.	6	7.22	3.07
Wed.	7	7.22	3.07
Thu.	8	7.22	3.07
Fri.	9	7.17	3.12
Sat.	10	7.17	3.12
Sun.	11	7.17	3.12
Mon.	12	7.17	3.12
Tue.	13	7.17	3.12
Wed.	14	7.17	3.12
Thu.	15	7.17	3.12
Fri.	16	7.12	3.17
Sat.	17	7.12	3.17
Sun.	18	7.12	3.17
Mon.	19	7.12	3.17
Tue.	20	7.12	3.17
Wed.	21	7.12	3.17
Thu.	22	7.12	3.17
Fri.	23	7.07	3.22
Sat.	24	7.07	3.22
Sun.	25	7.07	3.22
Mon.	26	7.07	3.22
Tue.	27	7.07	3.22
Wed.	28	7.07	3.22
Thu.	29	7.07	3.22
Fri.	30	7.02	3.27
Sat.	31	7.02	3.27

TOTAL HOURS DURING 1909.

	Hrs.Min.
January	428.30
February	358.15
March	353.10
April	298.10
May	263.20
June	234.45
July	248.30
August	278.00
September	311.25
October	370.05
November	397.40
December	438.35
	3980.25
Deduct on account of 50 min. extinguishing time	30.25
Total, yr.	3950.00

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Uses Two Feet of Gas per Hour.

Attaches to Any Gas Fixture.

Completely Hidden from View.

Use your own globe--either gas or electric.

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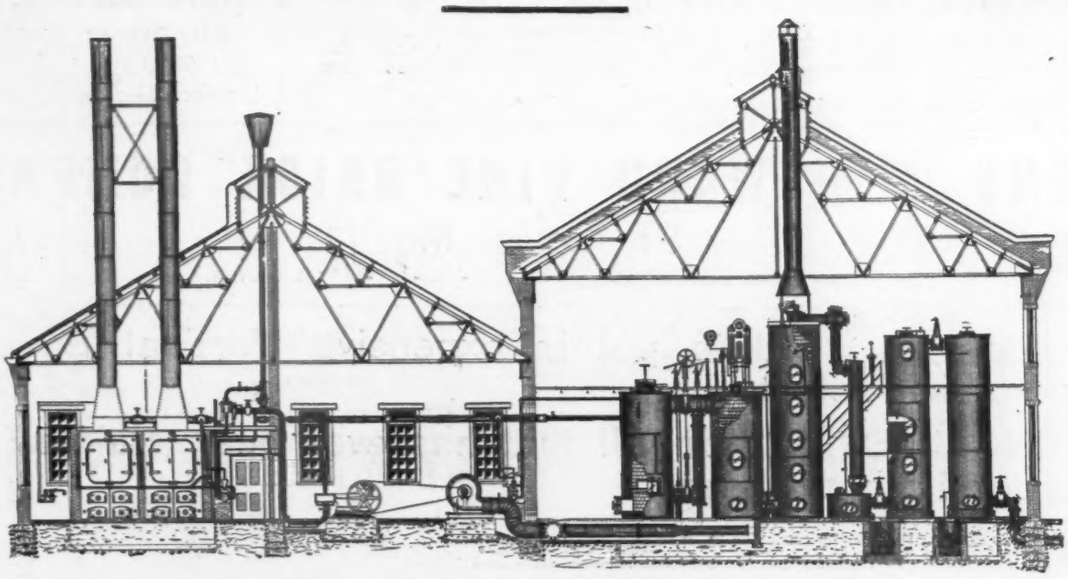

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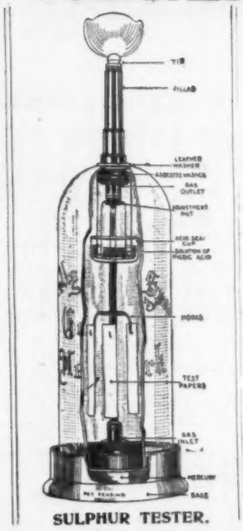

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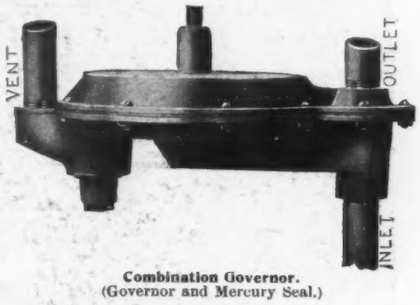

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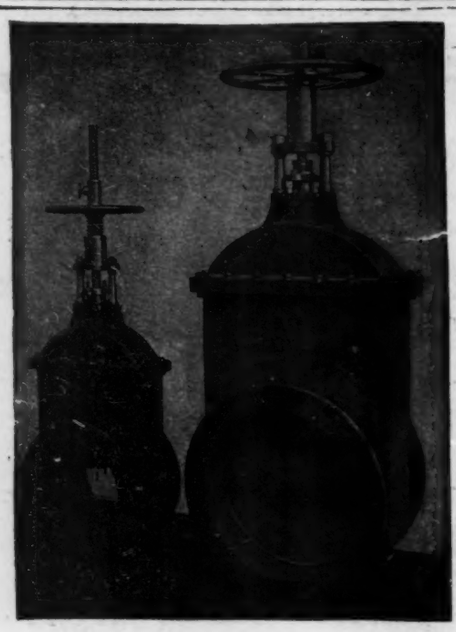

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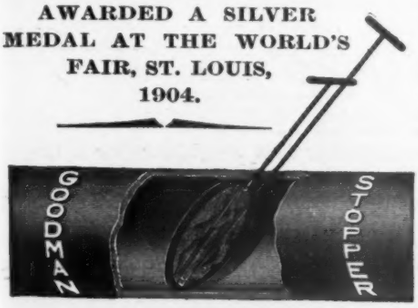

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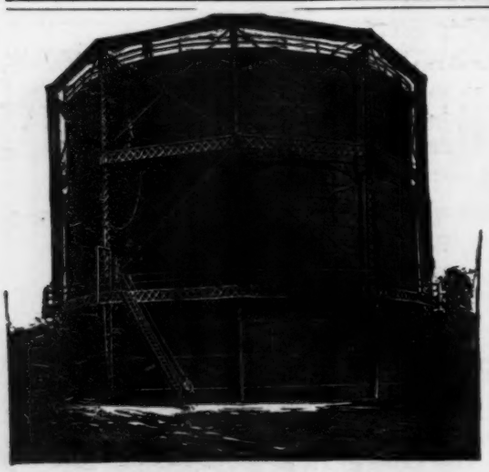

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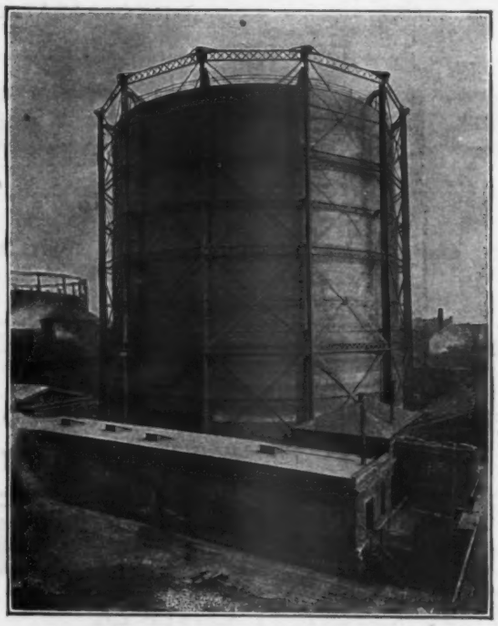

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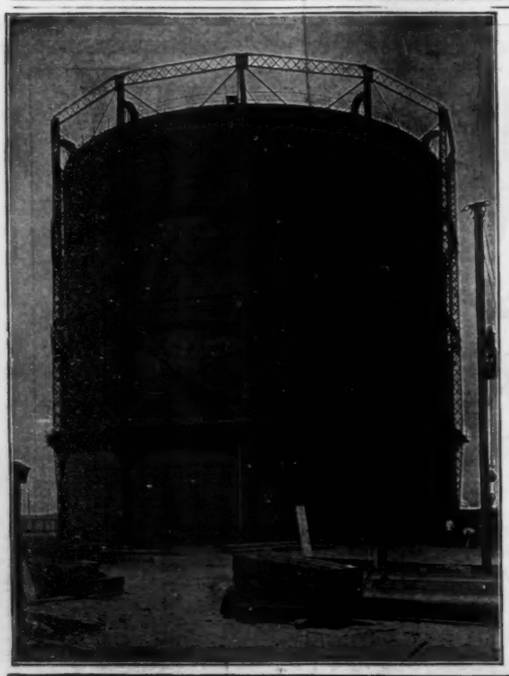

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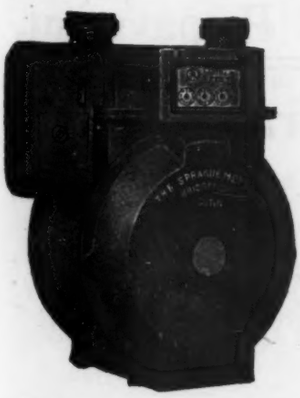

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